JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
AND
MECHANICS' REGISTER.

FEBRUARY, 1838.

Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General TREUSSART, *Inspecteur du Genie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(CONTINUED FROM P. 35.)

ARTICLE VII.—*Various Experiments on Mortars placed under water.*

Much importance has been attached to the manner of slaking lime. Mr. Lafaye published in 1777, a memoir in which he gives, as a secret recovered from the Romans, the mode of slaking lime by plunging it into water for a few seconds, and then withdrawing it to slake and fall to powder in the air. This powdered lime is preserved in a covered place Other Engineers have asserted that there is great advantage in stifling lime as it slakes; that is to say, covering it with sand before it begins to slake, in order to retain the vapours liberated during the process. Mr. Fleuret attributes great efficacy to this vapour, for he says "This vapour awakens and excites the appetite of the workmen, whence I conclude that it contains principles proper to the regeneration of lime and consequently to the hardening of mortars. But it is proved that nothing escapes but the vapour of water accompanied by some particles of lime. I made, on this point, the experiments contained in the following table.

Table No. XXV.

No. of the mortars.	Composition of the mortars.		No. of days required to harden in water.	Weight supported before breaking.
			days.	lbs.
1	Obernai lime slaked to powder with 1-5 of its volume of water being left in the air	1	15	176
	Sand	2 3		
2	Lime the same, slaked to powder with 1-5 of its volume of water being covered with sand	1	15	176
	Sand	2 3		
3	Lime the same, slaked by being plunged in water for 50 seconds	1	15	154
	Sand	2 3		

Observations on the Experiments of Table No. XXV.

To make the three experiments above, I took a piece of Obernai lime which I divided into three portions. The first portion was slaked by throwing on one fifth of its volume of water, leaving the lime at rest in the air for twelve hours before making it into the mortar No. 1. The hardening was slow because the experiment was made in November.

No. 2 was slaked in the same manner with this difference, that I covered the lime with the sand as soon as I had thrown on the water. This, also, was left to itself for twelve hours before making it into mortar. These two experiments gave, we see, the same results.

The third experiment differs from the first in this, that to slake the lime, I plunged it into water for fifty seconds—afterwards treating it in the same manner as No. 1. The result was less by 22 lbs. It is singular that I got the same results, as will be seen further on, by making similar mortars and leaving them in the air, instead of placing them under water. The result, it seems to me, is owing to the lime, immersed for fifty seconds, absorbing too much water, which is hurtful, as the experiments in the following table will show. I purposed repeating the trial, by varying the time during which the lime should be immersed, but I had not an opportunity.

We have seen, in tables Nos. IV, V and VII, that the Obernai and Metz lime soon lose a great part of their properties, when they have been slaked to dry powder and left exposed for some time to the air. It is true that a piece of Obernai lime gave me, in this way, the most favourable result of table No. VI, but only in the first month after slaking: for, afterward, this lime rapidly lost its quality. We ought then, by no means to apply the process of Mr. Lafaye to hydraulic limes, unless assured of a different result from mine, which, I think, need not be looked for.

As to fat limes, table No XIV shows that when they were slaked to powder, and left in this state, in the air, for a couple of months, I obtained, by mixing this lime with trass, results sensibly better than when I used lime just slaked. I think, therefore, that it is best to slake fat limes to powder and to leave them for a month or two in this state in the air, before using them in mixture with hydraulic cements; but the process of Mr. Lafaye may be much simplified, by throwing on the lime a quarter, or a third, of its volume of water: it was in this way that I operated; avoiding, thereby, the embarrassment of panniers or baskets. We have seen, above, that lime slaked to powder has the property of absorbing oxygen; and it is to that property I attribute the benefit derived from leaving lime exposed to the air after being slaked to powder. Table No. XV offers a similar result; but as the proportions were not the same, I do not know which of the two modes is preferable—slaking fat lime to powder, or reducing it at once to paste.* We see that in both cases, there is an advantage in not making the mortars immediately. If time had been allowed me I should have repeated these experiments; making the proportions the same. It sometimes happens that hydraulic lime has been wet, either in the lime house from carelessness, or out of doors, when slaked and covered with sand. I accordingly made the following experiments with lime slaked with more than the usual quantity of water—making mortars therewith at different periods.

* Comparing the series of Nos. 1 and 3 of table No. XV, we see that at the end of six months, lime slaked to powder supported 44 lbs. more than that slaked to paste. but in the following mortars, the advantage was only 11 lbs. which is but trifling. Au.

Table No. XXVI.

Composition of the mortar.	Made immediately.		After 12 hours.		After 24 hours.		After 36 hours.		After 48 hours.		After 60 hours.		After 72 hours.		After 84 hours.	
	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W
	d.	lb.	d.	lb.	d	lb.	d.	lb.	d.	lb.	d.	lb.	d.	lb.	d.	lb.
Obernai lime slaked to humid powder with a volume of water equal to the volume of lime measured in powder . . 1 Sand . . 2 } 3	15	242	16	209	20	165	22	132	24	121	26	97	30	77	32	66

Observations on the experiments of Table No. XXVI.

To make the above experiments I took Obernai lime fresh from the kiln, and slaked it by throwing on a bulk of water equal to the bulk of lime: thus slaked, it was in the state of powder, but on pressing it between the fingers it was felt to be a little moist. I made at once, a mortar, taking one part of this lime in powder, and two parts of sand; and I put it in water, after having left it for twelve hours in the air: I made other mortars in the same way, every twelve hours, and at the end of a year, I broke them all. The table shows that after twelve hours the mortar had already lost much of its force, since the second mortar supported 33 lbs. less than the first. That which was made after twenty-four hours lost 77 lbs., and at the end of thirty-six hours, this lime gave a mortar that had lost almost half its force. The table shows that the strength of these mortars went on diminishing in a very rapid manner, to the last, which being made after eighty-four hours, supported only 66 lbs., in lieu of the 242 lbs. which the same lime sustained at first. We see also, that the rate of hardening decreased in a very rapid manner. These experiments show how dangerous it would be to slake hydraulic lime with too much water, and how important it is to keep it from the rain. In the experiments I have made, I almost always slaked hydraulic lime with one-fifth of its volume of water, and fat lime with one-fourth; because, as we have seen in the first table, the latter absorbs more water than hydraulic lime, before being reduced to paste. But in slaking on a large scale, the workmen always waste a portion of the water on the ground: there will therefore be no disadvantage in slaking hydraulic lime with one-fourth, and common lime with one-third of its bulk of water.

The experiments in the above table explain why mortar No. 3 of table No. XXV gave a result inferior to the others: the reason is, probably, because during the fifty seconds that the lime was plunged in water it absorbed too great a quantity; and as it remained twelve hours exposed to the air, it lost part of its strength. I will now give some experiments that I made in in order to ascertain the influence of different quantities of trass on the qualities of mortars.

Table No. XXVII.

No. of mortars.	Composition of the mortars.			No. of days required to harden in water.	Weight supported before breaking.
				days.	lbs.
1	Fat lime slaked to powder and measured in powder	1			
	Sand	1	$2\frac{1}{4}$	19	103
	Trass	$\frac{1}{4}$			
2	Lime the same	1			
	Sand	1	$2\frac{1}{2}$	15	163
	Trass	$\frac{1}{2}$			
3	Lime the same	1			
	Sand	1	$2\frac{3}{4}$	10	216
	Trass	$\frac{3}{4}$			
4	Lime the same	1			
	Sand	1	3	8	301
	Trass	1			

Observations on the experiments of Table No. XXVII.

We see that in the above experiments I first used a very small quantity of trass, and that I augmented it little by little. No. 2, containing very little trass, gave a result superior to many mortars made of natural or artificial hydraulic limes: such a mortar would not be dear, and might be employed with advantage in gross masonry.

I made no experiments to determine the quantity of sand or factitious puzzalona that would suit the hydraulic and fat lime, of the neighborhood of Strasburg, because I think these experiments should not be made on a small scale. We have seen that the same quarry furnishes limestone giving different results. A multitude of essays, on several pieces of lime calcined to different degrees, would have been necessary, which would have demanded much time. Instead of following this course, I proposed, (after getting some facts as to proportions from the above experiments) to take mortar already made at the works, the lime being there slaked in large quantities at a time: repeating this several times, I should have determined the quantity of sand and hydraulic cement which it would be proper to mix with the lime used at the works: but I quitted Strasburg before it was in my power to make these experiments. There was used at that place, as I have before stated, one part of quick lime (measured as quick lime) to two and a half of sand: the mortar was good; as there was occasion to ascertain in several partial demolitions.

Mr. Raucourt has advanced the opinion that sands require different quantities of lime according to their degree of coarseness; and to know the quantity of lime, it will suffice to measure the void spaces between the particles of sand, these void spaces being the measure of the lime. Accordingly, he filled a vessel, successively, with several kinds of sand and determined the quantity of water which could be poured on each without overflowing the vessel, whence he obtained for each the quantity of lime that should be added. But experiments should be made to ascertain whether the best mortar is obtained when these voids in the sand are just filled with lime; this Mr. Raucourt has not ascertained.

Before the publication of Mr. Raucourt's work, Captain Henry Soleirol of the Engineers, had engaged in researches of the same sort. Capt Solei-

rel, also, thinks that no more lime should be added than will fill these void spaces in the sand. But his experiments presented anomalies difficult to explain; and they are not sufficient to cause us to admit the principle, in anticipation. This theory is ingenious, but it wants, as yet, the support of facts. The subject is important and deserves to occupy the leisure of Engineers.

The next table presents several experiments made with fat lime in reference to the manipulation of mortars.

Table No. XXVIII.

No. of the mortars.	Composition of the mortars.	No. of days required to harden in water.	Weight supported before breaking.
		days.	lbs.
1	Mortar in equal parts of fat lime, sand and trass, put in water immediately	18	290
2	Same mortar put in water after having been left twelve hours without being reworked	13	328
3	Same mortar reworked, after twelve hours, without water—and put in water twelve hours afterward	13	330
4	Same mortar reworked, after twelve hours, with a little water, and put in water twelve hours afterward	15	326
5	Same mortar, put in water after twenty-four hours—without being reworked	12	308
6	Same mortar reworked after twenty-four hours with a little water, and put in water twelve hours afterward	15	363
7	Same mortar, put in water after thirty-six hours without being reworked	12	319
8	Same mortar, reworked after thirty-six hours with a little water, and put in water twelve hours afterward	15	363
9	Same mortar, put in water after forty-eight hours without being reworked	12	319
10	Same mortar, reworked with a little water, after forty eight hours, and put in water twelve hours afterward	15	330
11	Same mortar put in water after sixty hours without being reworked	12	308
12	Mortar of one part of Obernai lime and two parts of sand, put in water immediately	15	154
13	Same mortar put in water after twelve hours exposure without being reworked	15	165
14	Same mortar, reworked with a little water after twelve hours, and put in water twelve hours afterward	12	198
15	Mortar of Obernai lime, sand and trass in equal parts, put immediately in water	4	405
16	Same mortar reworked with a little water after twelve hours, and put in water twelve hours afterward	3	528

Observations on the experiments of Table No. XXVIII.

It often happens that a good deal of mortar is prepared and that bad weather for a day or two prevents the workmen from using it. If it be hy-

draulic mortar, it becomes hard in the interval of a day, and often of a night, and it would be impossible to use it in that state. By reworking it for a long time, it might be brought to the proper consistence without any addition of water, but this is expensive: it is better to bring it to proper consistence by reworking it for a short time with a little water. Many Engineers think that mortar is improved by being worked several times a day: they consequently often make mortars several days before hand—work it well at first, and permitting it to stiffen, bring it again to proper condition by reworking, because, say they, *good mortars must be tempered with the sweat of the Labourer*: but the sweat of the Labourer costs money, which it is important to save. These considerations induced me to make the above experiments.

The first eleven mortars were composed of fat lime, sand and trass in equal portions. No. 1 was put in water immediately, while No. 2 was left twelve hours in the air, and then put in water without being reworked. This last we see gave a resistance sensibly greater than the first. Nos. 3, 4 and 5 remained twenty-four hours in the air before being put in water; No. 3 was reworked, twelve times, without water, No. 4 was reworked with water, and No. 5 was not reworked. It is important to remark that the results of No. 3 and 4 are very nearly the same as No. 2—No. 5 supported a weight sensibly less than No. 4.

After twenty four hours, it was not possible to rework these mortars without adding a little water. In consequence, Nos. 6 and 7 were put in water after thirty-six hours: with this difference between them, that No. 6 was reworked with a little water, while No. 7 was not reworked, No. 6, we see, gave a result decidedly better than No. 7.

Nos. 8, 9, 10 and 11, were made in the same way, and gave better results with those mortars that had been reworked with a little water, than with those that had not been reworked; at the end of sixty hours the resistance began to diminish.

If we compare Nos. 4 and 5, 6 and 7, 8 and 9, 10 and 11, which were left in the air, we shall see that those which were reworked with a little water, gave greater resistance than those which were not reworked.

If we compare Nos. 2 and 3, we see that this last mortar gained very little by being reworked, although it was worked over twelve different times. An excess of trituration, therefore, seems useless; for three or four pounds, more or less, of resistance, is almost nothing, when the mortars support 330 lbs.

Nos. 12, 13 and 14, were made with hydraulic lime and sand. The first two gave about an equal resistance; No. 14, which was reworked with a little water, was much the best of the three.

Lastly, Nos. 15 and 16, were composed of Obernai lime, sand and trass; No. 15 was put immediately in water. No. 16 was not put in until it had been worked with a little water. The latter gave a result much superior to the former.

I ought to mention that when the mortars had taken a slight consistence in the air, I always compressed them gently with the trowel before putting them in water; but Nos. 1 and 15 having been plunged into water as soon as made, were not compressed, while Nos. 4 and 16 were. I cannot think that so slight a compression has made so great a difference. We see besides that there is but little difference between Nos. 12 and 13, although this last had been compressed, while No. 14, which had been reworked with water, afforded a resistance much greater.

The mortars Nos. 12, 13 and 14, ought not to be compared with Nos.

15 and 16, first, because the last two contain trass, and, secondly, because the two limes were of different burnings. It results from the table, that when we have hydraulic mortar, composed of fat lime, sand and trass, or of hydraulic lime and sand, or mixed with trass; in either case, there is no disadvantage in reworking with a little water, when, from any circumstances, it has become too dry to be used. There is even an advantage in doing it; thus, in making mortar at night, and in the morning giving it a little water, and, by a little work, bringing it to its first condition, the mortar can only be improved thereby; but an excess of trituration is useless—not augmenting the strength of the mortar in comparison with the increase of expense. The following table contains several other experiments which I made on mortars.

Table No. XXIX.

No. of the mortars	Composition of the mortars.	No. of days required to harden in water.	Weights supported before breaking.
		Days.	lbs.
1	Mortar of one part of fat lime and two parts of trass	4	462
2	Same mortar with the same trass wet	4	451
3	Same mortar with the same trass not so fine as No. 1	6	231
4	Mortar made of 1 part of Obernai lime and 2 parts of sand, put in the water at the end of 12 hours, without being reworked	10	231
5	Same mortar, reworked after 12 hours, and put in water 12 hours afterward	10	220
6	Mortar of 1 part of Obernai lime and 2 parts of sand tempered thin	10	176
7	Same mortar—tempered stiff	10	161
8	Mortar of 1 part of fat lime half burnt and 2 parts of sand	12	110
9	Mortar of 1 part of Obernai lime and 2 parts of sand	10	253
10	Same mortar with the sand broken fine	15	132
11	Mortar of 1 part of Obernai lime and 2 parts of earthy sand	8	231
12	Same mortar, with the same sand after being washed		

Observations on the experiments of Table No. XXIX.

The first experiment was made with ordinary trass which had been sifted through a fine hair seive; it was thus that I used it in all my experiments. No. 2 was made of the same trass which I had left during a month at the bottom of a vessel wherein it was covered with water. Several constructors think it necessary to keep trass from moisture; this experiment proves there is nothing to fear from water. There is no disadvantage in leaving the pieces of trass, or of burnt clay of which artificial trass is made, exposed. But, when in a state of powder, it is necessary to keep it covered from winds.

No. 3 was made of the same trass which had been passed through a much coarser seive. The result, as we see, was inferior, by one half, which is not surprising, as I shall show in the sequel. It appears that it is important that trass and hydraulic cements be finely pulverized: there should be no perceptible asperities on taking the substance between the fingers. The two experiments Nos. 4 and 5, have the same object as the preceding table; they were made from lime of another burning. No. 4 was put in water after twelve hours exposure in the air, without being reworked. No. 5 was reworked without water after twelve hours, and put in water twelve hours afterward. If there is any advantage, it is rather in favor of the mortar which

was not reworked; but such slight differences may be regarded as nothing. We can conclude only, that when hydraulic mortars have been well mixed, which is the case when they appear homogeneous to the eye, nothing will be gained by any further labour. But we have seen by the preceding experiments, that if, after having left mortars at rest for some time, they be worked up anew with a little added water, increased force will be given to them. Nos. 6 and 7 were made with the same Obernai lime. Both were left in the air for twelve hours before being put in water, and all other circumstances were the same. The only difference being, that No. 6 was made into thin, and No. 7 into stiff mortar. There is a sensible difference in the resistances: and that both are feeble, must be ascribed to their being both made of a piece of inferior lime. The result is in opposition to the opinion of Mr. Vicat, for at the conclusion of a note that he wrote on the first experiments that I published, he says: "Mr. Treussart affirms, as respects the manipulation, that mortars tempered to ordinary consistency, that is to say, soft, are better than stiff mortars. This implies a contradiction, not only of facts generally observed up to this time, but also, in a measure, of the observations of the author himself."

I announced these results in 1823, because they are important in the manipulation of mortars, and were furnished by my experiments. I am fully aware they are in opposition to the opinion generally received; but I do not see in what they are opposed to my own observations, nor does Mr. Vicat inform us. They, on the contrary, coincide with all that precedes.

We have seen, in fact, that mortars gain sensibly, after they have somewhat hardened, by reworking them with a little water. We have also seen, at the commencement of this memoir, that fat quick lime, reduced to thin paste with water, is capable, for a long time, of absorbing fresh quantities of water. Is it not probable then that it is the same with hydraulic lime? When it has been reduced in paste to the consistence of common mortar, it is possible that it may not yet have absorbed all the water necessary to convert it into the best mortar. It is possible that a mass of mortar put in water, may absorb but a small quantity in consequence of its prompt induration. If so, it is not astonishing that a new quantity of water added to a mortar, after it has absorbed the first—or that a mortar made more fluid at first, should give the best results. The question is important, because it is much easier to mix mortars when they are thin than when they are stiff; and there results, consequently, a considerable saving. I was bound to give the results obtained with Obernai lime, in order to draw attention to them, and engage constructors using those sorts of lime, to experiment on the subject. All the mortars made at Strasburg, whether for works in water or air, were made of the consistence of common mortars, and very often, when, from any cause, they had somewhat stiffened, they were worked up anew with a little water, and we always had very good results.

Experiment No. 8 was made to verify an important fact announced by Mr. Minard, Engineer of Roads and Bridges. He states that by burning the lime feebly, so as to leave a portion of the carbonic acid in the lime stone after burning, a very good hydraulic lime will be obtained. I, in consequence, repeated his experiment, taking a piece of fat lime stone and placing it in the kiln above the tiles, so as to burn it but partially. I satisfied myself, by testing with muriatic acid, that, after this feeble burning, the piece of lime still contained much carbonic acid: but it had also lost so great a portion, that on throwing water on it, it was reduced to powder. I made mortar with this lime—mixing it with sand, and put it in water;

but we see that I obtained no result: at the end of a year the mortar was entirely soft.

Experiment No. 9 was made with the same lime and sand as experiment No. 10; the only difference being that No. 9 was made with common sand in its natural state, and No. 10 with the same sand after it had been broken up very fine. Both mortars were composed of one part of lime in paste to two and a half parts of sand. Many constructors think that coarse sand is preferable for gross masonry. We see, however, that the resistance I obtained with common sand, not coarse, was only 110 lbs., while that given by mortar made of the same sand after it had been pulverized, was 253 lbs. I confess that this result surprised me greatly. When I made these two mortars, which were put in water, I made two others of the same kind which I left in the air. We shall see, in the second section, that the mortar made of common sand broke under a weight of 187 lbs., while that which was made of the pulverized sand supported 275 lbs., although it was cracked. Commonly, the mortars put in water have given me, when made of hydraulic lime, better results than those left in the air. I am induced, therefore, to think that No. 9 gave a result so feeble in consequence of some circumstance that escaped notice. It is possible that the mortar was cracked without my perceiving it; and it, therefore, as yet, appears to me doubtful whether there can be so great an advantage, as I find in these two experiments, in making mortar of fine sand; although it seems certain that there is an advantage in the case of hydraulic limes, in making mortar of fine sand. Mr. Vicat obtained a similar result, as we see by his table No. XVI.

No. 11 was made of one part of fat lime in paste to two parts of an unwashed, earthy sand used at Phalsburg. No. 12 was made of the same lime and the same sand cleared of the earthy matter by washing. The washed sand gave me a result almost double that afforded by the earthy sand. It is therefore very important to use clean sand.

We find in vol. VII, of the *Annales des Mines* a discussion between Mr. Vicat and Mr. Berthier, as to the cause of the solidification of mortars. Mr. Vicat attributed it to the chemical action exercised by the lime on the siliceous matter. Dr. John, on the contrary, had established in principle, that the substances mixed with lime to make mortars, and which he denominates alloys, *(alliages,)* are altogether passive. He relates that, according to his experiments, caustic lime attaches neither quartz, nor any other stony substance. Mr. Berthier, who has examined this question, says, "I think, with Mr. John, that the alloys perform no chemical part in mortars; these alloys appear to me to have the effect, 1st, of diminishing the consumption of lime; 2d, of regulating the shrinkage, by moderating it, making it uniform and preventing cracks; 3d, probably, of facilitating dessication and the regeneration of carbonate of lime, and hastening the induration; 4th, of augmenting the solidity of mortars." According to Mr. Berthier, the molecules of the alloy contract with the molecules of the lime an adherence more or less strong. If this adherence be less than that which unites the molecules of lime to each other, the mortar will not be more solid than was the pure hydrate: it will, however, cost less, it will harden quicker, and will be less subject to crack in drying, which is of itself a great advantage. But if the force of adhesion of the lime be less than the force with which it adheres to the alloy, we may conceive that the mortar may acquire more tenacity than the pure hydrate; and this is, probably, what takes place in mortars.

Other philosophers, and several engineers, have thought that the solidifi-

cation of mortars was owing to the lime passing again to the state of carbonate, by absorbing carbonic acid from the air. This opinion cannot, however, be sustained; for we know that carbonic acid penetrates only very slowly into the portion of hydrate of lime which is exposed to the air. Very large masses of mortar, plunged into water, will sometimes acquire complete hardness in three or four days, while other mortars containing the same quantity of lime, and placed in the same circumstances, often take more than a month to indurate. Mr. Darcet analysed the mortar from the Bastile, and found the lime had only half the carbonic acid required to saturate it. Mr. John analysed several ancient mortars that were very hard, and found a much smaller proportion of carbonic acid. Besides, it by no means follows that all the carbonic acid found in old mortars, has been absorbed by the lime: for we know from experience that it is difficult to disengage all the carbonic acid from lime by calcination. The lime we use in our constructions often contains a great deal; and it is not, therefore, surprising that the analyses of old mortars show a great difference in this respect. The following, moreover, is a proof that the absorption of carbonic acid has no influence on the induration of mortars, at least in the beginning. I took hydraulic lime and reduced it to the state of hydrate with distilled water, making a rather thick paste, which I placed at the bottom of a phial; I then filled the phial with distilled water and corked it tightly; and when the lime was so much stiffened as not to run, I inverted the bottle, (still corked,) placing the mouth in a vessel full of water. I repeated the experiment with mortar made of hydraulic lime and sand, and with another mortar of fat lime and trass. These three substances hardened as quickly as if they had been put in water which was in contact with the air. Being deprived of all communication with the air, we cannot ascribe the hardening to carbonic acid. The surface of several old mortars exposed to the air has been observed to have passed to the state of carbonate; but only for a small depth, and it requires several centuries to produce even this change. The induration of mortars cannot, therefore, be attributed to the regeneration of carbonate of lime.

The reasons given by Mr. Vicat, and Mr. Berthier, on the question whether there is, or is not, a combination of lime with the substances united with it to form mortars, not appearing to me to be conclusive, I shall offer my own opinion on this subject, so important as regards the theory—presenting some facts in support of my views.

To account for the solidification of mortars in water, it seems to be necessary to divide them into two distinct classes; those composed of hydraulic lime and sand, and those composed of fat lime and puzzalona, or some analagous substance. As to mortars made of hydraulic lime and sand, it is not at all necessary to suppose that there is a chemical combination between those two substances, for we have seen by the first tables that the hydraulic limes, alone, when they are reduced to paste, harden promptly in water without it being necessary to mix any substance with them. We might be led to believe that there was a combination between hydraulic lime and sand by experiments Nos. 9 and 10, of table No. XXIX, which prove that the strongest resistance is given by fine sand; but, on the other hand, the facts cited by Mr. John, who found that sand was not attached by quick lime, and the reasons given by Mr. Berthier, lead to the belief that there is no such combination. To explain the hardening of mortars made of hydraulic lime, it is not necessary to suppose that it combines with the sand, since this lime hardens when alone in the water. It remains then to ex-

plain why hydraulic lime, itself, should harden in water. I will observe, on this point, that this particular lime is a combination of lime and a certain quantity of argil, by means of calcination; it is a substance, therefore, altogether different from lime, and it has acquired new properties that the lime had not: lime dissolves in water, while good hydraulic lime does not.

We know that when we mix, in certain proportions, soda, or potash, which are opaque, and soluble in water, with silex, which is also opaque, and heat the mixture, we obtain a new substance, which is transparent and insoluble in water, and which is called glass. It is not, therefore, astonishing that lime mixed with a little clay and heated, should produce a new substance that will harden in water, while lime alone will remain soft. Although we give to this compound the name of hydraulic lime, it ought, in fact, to be regarded as a substance altogether different from lime; it is a new body with new properties.

As to hydraulic mortars made of fat lime and puzzalona, or other analagous substance, I do not see that the hardening in water can be explained without supposing a combination between the fat lime and the puzzalona; for this lime, put alone in water, or mixed with sand, remains always soft. To prove the truth of this explanation, I made the following experiment: I took a mortar composed of one part of lime made from white marble, and two parts of puzzalona, which mortar had been one year in water. From the centre of this mortar I took a piece which I reduced to very fine powder, putting the powder in a vessel which I then filled with distilled water. But we know that if fat lime be put in water, the water will dissolve $\frac{1}{400}$ of its weight in a few minutes. Nevertheless, after twenty-four hours, the distilled water had no portion of the lime. I satisfied myself, on the other hand, that the lime of the mortar had not passed to the state of carbonate: because, on throwing muriatic acid on the powdered mortar, there was very little effervescence. The lime had not therefore passed to the state of carbonate, and still it would not dissolve in water, which could only proceed from its state of combination with the puzzalona.

I communicated this fact nearly two years ago to Mr. Berthier, giving him a little of the pulverized mortar which I used in my experiment, and he obtained the same result that I did. I will add that I made some hydraulic mortar by mixing one part of fat lime measured in paste, with two parts of puzzalona; one portion of this mortar I placed at the bottom of a glass, and covered it immediately with water; the other portion was also placed in the bottom of a glass, but was not covered with water till after the lapse of twelve hours. A strong pellicle of carbonate of lime formed all over the surface of the water which had been put on the fresh made mortar, while in the case of the mortar that had been twelve hours in the air before being covered, there was only a light pellicle of carbonate of lime on portions of the surface of the water; more than half the surface of the water was without any pellicle. This experiment proves that lime combines very promptly with puzzalona.

The hardening of hydraulic mortars in water may be explained, then, in the following manner: if the mortar be made of hydraulic lime and sand, this last substance appears to be in a passive state; the induration of mortar takes place because hydraulic lime hardens of itself in water—this being a property resulting from the state of combination of a small quantity of clay with the lime. If the proportion of lime be too much forced, a good hydraulic lime will no longer be obtained. A similar effect occurs in making glass: if the quantity of soda or potash be too much forced, the re-

sult is nearly a deliquescent compound. When hydraulic lime is made of fat lime and puzzalona, the hardening takes place because there is brought about a combination of fat lime and puzzalona in the moist way. In this case—that the combination may work well, it is requisite that the puzzalona be in greater proportion than the lime.

There is always a reduction of volume, in making mortars, on the mingling of the constituents. I have endeavored to measure this diminution by experiments on a large scale. First, four heaps, composed each, of 10.60 cubic feet of Obernai quick lime, and 21.20 cubic feet of sand—making altogether 127.20 cubic feet, became reduced by manipulation to 101.71 cubic feet of mortar of ordinary consistence: the volume diminished therefore in the ratio of 1.00 to 0.80—that is to say, was lessened 0.20. In a second experiment, fifty eight heaps,* composed each of 10.602 cubic feet of quick lime, and 26.505 cubic feet of sand, forming together a volume of 2152.21 cubic feet, produced 1779.955 cubic feet of mortar. The primitive volume diminished, therefore, in the ratio of 1.00 to 0.822—that is to say, was lessened 0.178. According to the first experiment, the reduction was one fifth: and in the second, where there was more sand, it was about one sixth. These facts will be useful in making analyses, to determine prices.

Mr. Lacordaire, Engineer of Roads and Bridges, engaged on the canal of Bourgogne, has announced that he has obtained good hydraulic mortars by the following means. He burnt hydraulic lime stone but partially, and slaked it by immersion. The portions the most burned fell to powder; and the lime thus furnished he used by mixing it with sand, and with the portion of the lime stone that did not slake; which portion he pulverized and used as a cement. There has been established, at Pouilly, a manufactory of this substance, to which the name of Pouilly cement has been given; and as a cement, it is mixed with fat lime. We see that Mr. Lacordaire has applied to hydraulic lime, a process analagous to that which Mr. Minard proposed for fat lime stone, and which in our trials gave no results, as may be seen page 80.

I procured two specimens of the hydraulic lime stone of Pouilly, and also a piece of the half burnt lime of which the cement of that name is made. One of these lime stones is a distinct blue, and the other of an ash colour. The piece of half burnt lime was of a brown colour, and had been out of the kiln about six months. I made with this half burnt lime the following essays: I detached a piece on which I poured water; there was no heat given out, and it did not fall to powder. I then put a piece in muriatic acid diluted with a little water; there was considerable disengagement of carbonic acid, and it dissolved, leaving a residue of about one fifth, which was clay mixed with a little red oxide of iron. I reduced the piece still left, to a very fine powder, and made therewith the following experiments: I first mixed one part of fat lime measured in paste, with two parts of this powder. After having well mixed the whole with a little water, to bring it to the consistence of sirup, I placed it in the bottom of a glass. One hour afterward I was obliged to cover it with water, because it became consistent. Twelve hours after being covered with water, it was completely hard. I made a second experiment by reducing the powder, alone, to paste with water, and in an hour after being placed in the bottom of a glass, it was covered with water; at the end of twelve hours the induration of this, also,

*In the original, it is 52 heaps, which must be a misprint, as it requires 58 heaps to make up the quantity of 2152.21 cubic feet.—*Trans.*

was complete. Lastly, I made a third experiment with one part of fat lime and two parts of this powder, as in the first essay; but I added no more water than was requisite to reduce the mixture to a thick paste, and I left it in the air; it hardened with as much promptitude as plaster of Paris: and fifteen days afterwards it appeared to possess very great hardness. It will be possible, perhaps, to substitute this substance for plaster advantageously.

It results from the essays just given, that this matter reduced to paste with a little water, hardens in water, and in the air, with great promptitude; and that, employed in powder with fat lime, in the manner of puzzalonas, an equally prompt hardening is obtained. It appears to me that the name *cement* given to this substance is not suitable; for it is, really, a subcarbonate of hydraulic lime, that is to say, an hydraulic lime but little burnt, and containing, consequently, much carbonic acid. I may here observe that if we mix one part of fat lime with two parts of good hydraulic lime reduced to powder, this mixture will, equally, harden in water, without our being authorized to say that this powdered hydraulic lime is *cement*. This name belongs only to the powder of burnt clays; it is possible, however, that usage will preserve to this substance the name of cement, since it is used in the same manner as cement.

The fine observation of Mr. Lacordaire opens a new field as to hydraulic mortars. It will be very important to ascertain the tenacity of this substance; for we have seen by the Boulogne pebbles, and by several other mortars, that those which harden very quickly do not offer a great resistance. We have seen by table No. III, that several hydraulic limes, well burned and reduced to paste with water, have given, alone, greater resistance than when mixed with sand. The great promptitude of induration of these slightly burned limes merits particular attention. To judge accurately of this new mode of employing hydraulic limes, it will be necessary to make comparative experiments, first of the same lime stones, both slightly burned and thoroughly burned, made into paste with water; afterward by mixing them with a great quantity of sand; lastly, the lime but slightly burned should be used as cement with fat lime and with hydraulic lime, and with each of these kinds of lime united to sand. The hardening of the several mixtures should be compared; and at the end of a year they should be submitted to rupture, to determine their tenacity. Supposing that one part of fat lime, mixed with two parts of lightly burned hydraulic lime used as cement, should give a resistance equal to that afforded by mortar composed of the same hydraulic lime well burned and two parts of sand, it will then be necessary to examine which of these two processes is the cheapest.

In the first case lime only, which is a dear substance, is used; but the hydraulic lime, which composes two-thirds of the mortar, being much less burned, requires less fuel, at the same time that it requires a good deal of labour to pulverize it. We see, then, that it is by comparing the expense, with the resistance, of mortars, that we can fix upon the process to be adopted. There are circumstances, undoubtedly, where it is important to secure a speedy induration; but in ordinary cases, there is no inconvenience in waiting eight or ten days to allow the concrete, or mortar, to take sufficient hardness. It is to be presumed that we shall, ere long, have experiments which will show us whether this new mode of employing hydraulic lime presents advantageous results, as respects the tenacity of mortars. In those places where good hydraulic lime is found, it is very important that the experiments, of which I have spoken, should be made.

I have said that the half burned lime which I used as cement, had been

calcined for six months; and that I obtained, nevertheless a prompt induration. That might be owing to its being still a stone, and that the air could not penetrate to the interior. It will be important to ascertain whether this lime will preserve its energy thus long, when reduced to powder. It will be equally necessary to know if it be indifferent whether this lime be plunged in water as soon as it is burned; or if it be preferable to half burn the whole kiln, so that it shall receive no water until it comes to be mixed into mortar with thorough burned lime.

We find in the VII volume of the *Journal des Mines*, the analysis, made by Dr. John, of several old mortars; and by Mr. Berthier of several lime stones. I will terminate his article by the exposition of these analyses in the following tables.

Analysis by Dr. John of several Mortars.

	Mortars in air.						Hydraulic mortars.		
	1	2	3	4	5	6	7	8	9
Carbonic acid	0.0600	0.0575	0.0175	0.0500	0.0900	0.1200	0.0050	0.0225	0.0225
Lime in the state of carbonate	0.0800	0.0781	0.0260	0.0663	0.1194	0.1591	0.0070	0.0295	0.0298
Lime combined with other substances	0.0170	0.0431	0.0565	0.0207	0.0322	0.0809	0.0305	0.0395	0.2977
Combined silex	0.0100	0.0115	0.0375	0.0125	0.0025	0.0025	0.0200	0.0035	0.0800
Quartz and sand	0.8000	0.8010	0.7850	0.8375	0.6884	0.5600	0.7750	0.8950	0.3500
Alumine—oxide of iron					0.0275	0.0275			
Water . .	0.0330	0.0088	0.0675	0.0130	0.0400	0.0500	0.1625	0.0100	0.2400
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

1. Mortar one hundred years old, from the exterior joints of St. Peter's, at Berlin.

2. Mortar a hundred years old from the interior joints of the same church.

3. Mortars six hundred years old, from a covered (*encombrée*) foundation of the same church.

4. Mortar six hundred years old, from the walls of the Cathedral of Brandeburg.

5. Roman mortar, from the wall of a tower built at Cologne under Agrippa in the first century of the Christian era.

6. Roman mortar from a tower built by Agrippa.

It appears that in these last two mortars the portion of lime not saturated with carbonic acid is combined with the alumine.

7. Mortar three hundred years old, from the outside wall of the old castle of Berlin.

8. Old Roman, hydraulic mortar.

9. Mortar from Treves four years old.

We see by the above table that none of these mortars contain, by a notable quantity, the portion of carbonic acid required to saturate the lime; since according to the analysis of page 230, vol. xx, lime-stone contains, ordinarily, 33 per cent of carbonic acid. Mortar No. 5, for example, which was nearly two thousand years old, contained only about 13 per cent; and it is to be noticed, as I have already said, that the lime, as we use it in our constructions, is never completely deprived of this acid. We notice also that

the hydraulic mortars are those which contain the least carbonate of lime. And lastly that a part of the lime is found united chemically with other substances, such as silex alumine, and iron, and perhaps with all three at the same time. These substances appear to be combined with the lime by calcination.

Lime produced by different calcined limestones, yielding common lime according to the analysis of Mr. Berthier.

	Fat Lime.						Meagre Lime.	
	1	2	3	4	5	6	7	8
Lime	0.964	0.954	0.972	0.935	0.916	0.860	0.780	0.600
Magnesia	0.018	0.018	0.000	0.010	0.015	0.090	0.200	0.262
Clay	0.018	0.028	0.028	0.040	0.069	0.050	0.020	0.000
Oxide of iron &c.				0.015				0.138
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

1. Limestone of the fresh water formation of Chateau—Landon near Nemours; compact, yellowish, a little cellular, sonorous: yields very fat lime.

2. Limestone of Saint-Jaques; compact, yellow, texture somewhat saccharoidal; it forms the base of the Jura mountains; makes a very greasy lime which hardens but slowly.

3. Lower marine limestone (*calcaire grossier*) of Paris: gives very greasy lime.

4. Limestone which forms the roof of the iron mine of La Voulte (Ardiche;) compact, yellowish white: containing shells which prove it to be contemporaneous with the Jura limestone, specific gravity 2.67: gives very good fat lime.

5. Limestone of Lagneux (Ain:) compact, of a light yellowish gray; affording fat lime which is much used at Lyons.

6. Fresh water limestone of Vichey (Allier:) compact, cellular, yellowish white, gives very good lime, but not very greasy.

7. Limestone of the neighbourhood of Paris, which appears to belong to the fresh water formation: compact, yellowish; gives meagre lime, but not hydraulic.

8. Secondary limestone of Villefranche (Aveyron:) lameller, of an ochery colour, the lime obtained in an experiment on a small scale was very meagre without being hydraulic.

Limes produced by different limestones, yielding hydraulic lime according to the analysis of Mr. Berthier.

	Moderately Hydraulic.					Very Hydraulic.					
	1	2	3	4	5	6	7	8	9	10	11
Lime	0.870	0.830	0.840	0.820	0.820	0.745	0.688	0.740	0.683	0.700	0.746
Magnesia	0.040		0.025	0.015	0.015	0.035	0.060	0.020	0.020	0.010	0.160
Clay	0.090	0.070	0.135	0.165	0.165	0.220	0.252	0.170	0.240	0.290	0.078
Oxide of iron &c.		0.100						0.070	0.057		0.016
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

1. Limestone of Vougny (Loire;) sub lamellar, yellowish, filled with ammonites and other shells; yields very good lime which sets in water.

2. Limestone of Saint-Germain (Ain;) compact, deep gray, veined with white carbonate of lime; lamellar, and penetrated with gryphites, &c., at Lyons this lime is used for hydraulic works.

3. Limestone of Chaunay near Macon; compact, fine grained, yellowish white, it is of the secondary formation: this lime is hydraulic.

4. Limestone of Digne (Jura;) compact, penetrated with plates of calc. spar (*lamelleo de calcaire*) and containing a great number of gryphites, of a deep gray, this lime is hydraulic.

4. Limestone which accompanies the preceding, and which possesses the same properties; compact, of a grain almost earthy; of a clear gray.

6. Secondary limestone of Nimes (Gard;) compact, yellowish gray; affords a hydraulic lime which is there considered of excellent quality.

7. Lezoux lime (Puy-de-Dome;) made of a fresh water calcareous marle; it is said to be excellent, they are in the habit of slaking it by leaving it in heaps in the air, after having moistened it: it produces a copious jelly with acids.

8. Compact limestone of an unknown locality: gives very good hydraulic lime.

9. Secondary limestone of Metz (Moselle;) compact, of a grain almost earthy, of a bluish gray more or less deep: the lime it affords is known to be very hydraulic.

10. Calcareous marle of Senonches, near Dreux (Eure-et-Loir;) compact very tender, may be diffused through water like clay, but does not fall to powder when burnt. This substance is not like the limestones which have an earthy fracture, a mixture of carbonate of lime and clay. It leaves in acids a mealy residue, soft to the touch, which contains only a trace of alumine, which dissolves in liquid caustic potash even when cold, and which comports itself in all respects like silex which has been separated from combination: nevertheless it is certain that this substance exists in the Senonches lime only in the state of mixture: because, by operating with great care, we find by analysis, that the proportion of carbonic acid is exactly that which is necessary to saturate the lime. I have, before, in some varieties of carbonate of magnesia (*magnésie carbonatée,*) encountered silex soluble in alkalis, although not in combination, but have never found it in carbonate of lime. The Senonches lime is very well known: it is much used at Paris: it hardens more promptly, and acquires greater hardness than Metz lime: it dissolves in acids without leaving the least residue. (What Mr. Berthier says here of this lime is very remarkable and deserves to fix attention on this particular kind of lime.)

11. A mixture of four parts of chalk from Meudon and one part of Passy clay (in volume,) which Mr. Saint-Leger uses to make the artificial hydraulic lime of Paris.

If we compare the common limes of the first table, above, with the hydraulic limes of the second, we shall see, 1st. that the latter contains, in general, much more clay than the former: 2d., that several limes contain more than two-tenths of magnesia, without being hydraulic, while they become eminently so, when they contain the same quantity of clay: 3d., that almost all the common limes contain a small portion of clay. We see that No. 5 of the common limes contains, within one thousandth as much clay as No. 2, of limes moderately hydraulic: it is probable that these two limes have about the same degree of hydraulic property, but that it is weak. It

would be interesting to know the resistance of the mortars made of all the limes contained in the above two tables. It is only by determining the tenacity of mortars made of limes of which the composition is well known that we can adjust the composition and proportion of clay so as to produce the best hydraulic limes.

Article viii.—*Of Sand, and Hydraulic Sand (Arénes.)*

Sands are classed relatively to their constituent parts: thus there are siliceous sands, granitic, calcareous sands, &c., some sands result from the slow decomposition of rocks of the same nature. Sometimes they are mixed; and it often happens that they contain several metallic substances—principally iron.

The different revolutions that the earth has undergone have caused considerable deposits of sand in places where there are now no water courses; and even at great elevations. On certain coasts there are extensive collections of sand, which the French calls *dunes;* these are heaped up by the winds. Rivers transport a great deal of sand, and their shores are sometimes covered with it. Sands are often mixed with vegetable earth. In this case they are not proper for mortar. To be suitable to this end, they should be almost perfectly free from earthy matter. When on the subject of mortars exposed in the air, I shall point out a very simple means, that I have used for several years, of freeing sands from the earth they contain.

Constructors distinguish sands into *river sand*, *sea sand* and *pit sand.* This last is found in the great deposits mentioned above: it bears the name of *fossil sand*, also: its grain is generally more angular than that of *sea sand* or *river sand.* All these sands contain the same elements. Siliceous, or granitic sand, or a mixture of the two, are most common: calcareous sands are most rare.

Vitruvius, and others after him, thought that *fossil* or *pit* sand was the best for making mortar. Belidor thought, on the contrary, that *river sand* was preferable. Mr. Rondelet has since made experiments which appear to establish that *pit sand* is better than *river sand.*

I purposed examining whether, in fact, there was much difference, in making mortars of one sand rather than of another: but I quitted Strasburg before I could apply myself to the subject. Nevertheless, some facts, of which I shall speak when on the subject of mortars exposed to the air, lead me to believe that the divergence of opinions, as to which are the best sands, results from the experiments having been made with sand more or less fine, or more or less earthy. The experiments cited page 81, show that earth mixed with sand is very injurious to mortars. But the authors quoted above do not say whether, before making these experiments with pit and river sand, they took care to wash both of them. If they did not wash them, the superiority which they found to belong to either, may have been, on one hand, due to the greater freedom from earthy matters of the better sand of the two, and on the other, to the greater fineness of the particles. My results were obtained with granite sand, and it remains to be ascertained whether they would have been the same with other kinds of sand. The question is important, and should be examined with care.

A species of fossil sand has lately been discovered, which is very remarkable: the knowledge of this singular substance is due to Mr. Girard de Caudemberg, Engineer of Roads and Bridges. This Engineer published,

in 1827, a very interesting notice of this subject, which cannot fail to produce important results. I will state succinctly the principal facts contained in this notice, and I will add some observations that have been made since.

"There exists" says Mr. Girard," in the valley of the river Isle, fossil sands of which the colour varies from redish brown to yellowish red and even ochre yellow. They are called '*arénes*,* which denomination we shall preserve in this notice, to distinguish them from common sands. These sands are often used alone, as mortar, in walls of enclosures and of houses; and as they have the property of making a paste with water, and as they shrink less than clay, they are very proper for this kind of construction: they represent in this case a *pisé*, which acquires hardness and resists inclemencies. But the proprietors of the mills on the river Isle, in the department Gironde, discovered by accident a quality in the *arenes* much more important and worthy of serious attention; they use it with common lime more or less fat, to form mortars which set under water and acquire great hardness."

Mr. Girard says that for want of hydraulic lime, he made several Locks with mortar composed of common lime and *arenes*. He states that he obtained very good results; and that the following year it was necessary to use the pick to break up the concrete that had been made with these *arenes*.

The examination of the *arenes* showed Mr. Girard that they were all composed of sand and clay in various proportions. By means of washing and decantation he separated the clay from the sand, and in eight kinds of arenes he found the proportions of clay varied from ten to seventy per cent. He ascertained that those arenes which were meagre, were hydraulic only in a very feeble degree. The sand of the arenes is sometimes coarse and sometimes fine: it is occasionally calcareous, but more frequently siliceous or mixed. Some of the arenes are red, others brown, yellow and sometimes white.

The arenes are generally found on the summit of the hillocks which form the basins of rivers and brooks: they are rarely found in valleys. The deposits of the substance are superimposed on masses of argillaceous tufa (*tuf argileux*,) or calcareous rocks; they have all the characters of an alluvial deposit. The beds are often separated by pebbles. Rolled pebbles are, moreover, often seen disseminated here and there in the mass. Some of the beds are more than fifty feet thick. Mr. Girard says it appears to him that the environs of Bordeaux, and the valleys of the Aube and upper Seine, contain a great deal of it; and that it exists in a multitude of localities.

Mr. Girard had occasion to ascertain that the arenes were employed in many ancient constructions, and he cites, among others, the thick revetments of a remnant of fortification at Mucidan (Dordogne) which dates back several centuries, and it appears that the very old constructions at Nimes were made with arenes.

Mr. Girard says he has assured himself by experiments that in preserving for a year under water, mortars containing equal proportions of crude energetic arenes, and the same arenes calcined, that there was no appreciable difference in their consistence; but that the torrefaction of the arenes

* It appears that the word *arène* was known to several Constructors, for Mr. Sganzin says page 25, in speaking of Sands: "They call *arènes* those of which the particles are finer and more regular." And this is all he says. Au.

had the advantage of hastening in a remarkable manner, the setting or induration of the concrete.

Mr. Avril and Payen discovered, about the same time, in Bretagne, the properties of puzzalona, in gray wacke, and in decomposed granite, though to a degree quite feeble. They remarked, besides, that natural puzzalonas acquire a new degree of energy by a slight calcination.

Captain Leblanc of the Engineers, employed at Peronne, gave on the 30th November 1827, an interesting memoir on the arenes which are found in great quantity in the neighbourhood of that place. I will transcribe the commencement of the memoir. "In the numerous demolitions, made in 1825 and more especially in 1826, preparatory to the repair of the crown work of Paris, it was remarked that the ancient mortars (from 150 to 600 years old) were generally very hard. It was particularly noticed, at the time of the demolition of the piers of bridge forty-one, which was situated in quick sand, below the level of the waters, that the mortar was harder than elsewhere. To these facts the only exception was in the demolition of scarp thirty-three at the close of the year 1826. The mortar of this masonry was still soft. On examining the mortars which were hard, it was perceived that the sand therein was very fine, and that these mortars, from their aspect, seemed to have been made of the sand of the country, rejected in the official instructions, because too earthy. (This sand is used in all the constructions of the town.) Another consideration led to the belief that the sand of the country had been used: for all this masonry appeared to be very carelessly put together; the mortar, badly made, showed every where, lumps as large as a hazle nut, of lime not mixed with sand and still soft; although all the surrounding mortar was very hard. It was to be presumed that when applying so little care to all parts of the workmanship, the constructors had taken no greater, as to the choice of sand: and that they used that which was nearest at hand—namely the sand of the country. We have said that the mortar of scarp thirty-three was found still soft after two hundred years: it seemed on examination to be meagre; and, although the sand seemed to be the sand of the country, the mortar did not look like the other; under these circumstances, this example suspended, for the time, the conclusions that had already been drawn as to the advantage of using the Peronne sands."

The author states that on recommencing labours in 1827, he made six cubes of mortar, of which three were composed of sand recommended in official instructions, and the other three of the clayey sand whereof the good masonry appeared to have been made. One cube of each kind of mortar was left in the air, one put in a humid place, and one in water.

It was in this interval, as Capt. LeBlanc states, that the notice of Mr. Girard appeared. What was said in that notice showed that the clayey sand of the neighbourhood of Peronne was a true arene. The mortar made of common lime and this arene had completely hardened in the water at the expiration of a month; so as to receive no impression when borne upon strongly by the thumb. A mortar made at the same time of the same lime and of the sand recommended officially, and usually employed, remained entirely soft at the end of several months. By heating the arenes, Capt. LeBlanc ascertained that the hardening took place much more promptly, for the mortars made of the crude arenes required a month to harden, whereas those made of arenes that had been heated, hardened in eight or ten days. This officer undertook some experiments to determine the degree of calcination proper to impart the quality of most prompt hardening,

and to ascertain whether the effect of calcination would be to augment in a sensible manner, the strength of mortars, but his experiments are not yet finished. The discovery of arenes in the environs of Peronne, is, at all events, a great advantage for the works in progress at that place. Masonry in the air may be executed with crude arenes; and if it appear that calcination augments both the promptitude of hardening and the solidity of mortars, this operation might be resorted to in all cases of constructions in water.

The arenes of the environs of Peronne are found on the tops of the hillocks which border the valley of the Somme, like those of the valley of the Isle, and they lie upon a calcareous mass. Towards the bottom of the river banks, the arenes are mixed with fine sand, and moderately fine sand, and sometimes, with coarse grains. It is only towards the tops of the hillocks that they are found composed entirely of fine sand. The inhabitants call it clay. It is found, also, on hills quite elevated. Capt. LeBlanc states that the arenes which contain only very fine sand are less hydraulic than those which lie a little lower and which contain a mixture of fine and moderately fine sand; that in those places where the ground rises gently from the river, the banks of sand are always mixed with, and sometimes separated by rolled or broken pebbles, which is another point of resemblance with the arenes of the valley of the Isle, as described by Mr. Girard. The colour of these arenes is obscurely reddish, a good deal resembling bistre: they present the appearance of an ochrey earth.

Capt. LeBlanc adds that since the discovery of the arenes of Peronne, they have been found at Bapaume, at Douai, on the road from Bethune to Arras, and that this substance appears to be very common in the valley of the Somme, and in Flanders. At Bapaume, the workmen have known for a long time that this clay was hydraulic: the millers of the neighbourhood having executed works in the water therewith, with very good results. In the month of July last, Captain LeBlanc informed me that there had been found in the neighborhood of Ham, an arene pronounced to be more hydraulic than that of Peronne, and that it was used a long time ago in the fortifications of the castle.

I procured some of the arenes from Ham: they sent me two kinds; one yellow and the other greenish. We shall see in the sequel that they are clays. I satisfied myself that they contained no lime. I made two kinds of mortar therewith, taking one part of lime in paste to two parts of the arenes, and put them under water. I made a similar mortar with puzzalona. The puzzalona mortar hardened completely in six days: the two mortars made of arenes had not fully hardened at the end of three months. These experiments were made last December, which retarded the induration no doubt; but being placed in a chamber where the temperature was about ten degrees, (cen?) (50 Far.,) I was astonished at the slowness of the induration.

I calcined some of the greenish arene, keeping part at a low red heat for half an hour in a crucible; another part during one hour; and a third portion during two hours. I then made three mortars like the above, with these three calcined arenes. The two mortars of the arenes, calcined, one for half an hour, and the other for an hour, hardened in a month. That calcined for two hours, required nearly two months to attain the same degree of hardness. It is true that I did not calcine this substance in a current of air; but I was surprised that, being calcined, it did not harden sooner. It will be important to make many experiments on different arenes, crude,

and calcined in various degrees, so as to know the greatest promptitude of induration that can be secured, and the tenacity of mortars both in air and water.

Two specimens of mortar taken from the Castle of Ham were sent to me: one of these mortars was made in 1601, and the other in 1802; they were both of very strong consistence. I found, nevertheless, that they did not offer the same degree of hardness as mortars made of trass and hydraulic cement; but these arenes will be not the less advantageous in constructions in water and in air, on account of the great economy that attends their use. In places where good arenes are at hand, they should, in cases where a prompt hardening is required, in caps of arches, &c., always be employed mixed with hydraulic cement.

I had occasion to notice, a short time since, between the park of Versailles and Saint Cyr, a hillock of clayey sand which looked to me like the sand from Ham: some was yellow and some red; the colours being well separated. I made with these two clayey sands, two mortars composed of one part of fat lime and two parts of these sands, and placed them in water. They were not indurated at the end of four months, but it was perceptible to the touch, that they had taken a degree of consistency.

At Paris they build the walls of houses with plaster, and cellar walls with mortar. I have had occasion to observe latterly, that several of these mortars were made of clayey sand which appeared to me to be a species of arene: it contained a little lime, and some of it is yellow, and some greenish, like that from Ham. I learned that this sand was brought from the neighborhood of the ancient garden of Tivoli, and that it appears to have been employed at Paris for a long time to improve mortars. I made two mortars of these two clayey sands, adopting the same proportions as with the sands from Saint Cyr, and placed them in water. The results were similar to those given by the clayey sands from Saint Cyr. From what has been said, we see that these clayey sands are arenes of little energy: they do not appear to me to be proper for mortars that are to be placed in water; but the hydraulic property they possess, feeble as it is, will give, for works in the air, much better mortar than ordinary sand. From what has been stated above, it appears probable that there exist several banks of arenes in the neighborhood of the Capital; and it is probable some may be found more energetic than those I tried; it will therefore be important to make researches, adopting the same process as is recommended page 31, for cements.

If we mix clay with fat lime, the resulting mortar will take no consistence when put under water. It is necessary that clays be more or less calcined to become hydraulic. Mr. Girard seems to think that the arenes have been submitted to the action of fire, and that perhaps they have a volcanic origin; but this second assertion does not seem to be a necessary consequence of the first; all that we may affirm is, that the arenes are clays which have sustained the action of fire. On the other hand, the small rounded stones and pebbles found in some of these deposits, prove that they are, also, alluvial. It is not easy to meet important facts without seeking to account for them, although at the risk of deceiving ourselves.

The flattening of the poles of the earth, and the swelling out of the equator, demonstrate that our globe has been in a soft state. Some philosophers maintain that the earth was in a state, primitively, of fusion; these are called *Vulcanists*. Others contend that the softness of the earth was an effect of water; these are called *Neptunists*. The opinion of the *Vul-*

canists is a very ancient one, and prevailed for a long time; but the great number of shells, the remains of marine animals, and other objects, encountered at very elevated positions, superseded the opinion of the *Vulcanists* with that of the *Neptunists.* Later still, new observations, and amongst others, the great heat of certain thermal waters; the elevated temperature which is found at the bottom of very deep mines; the sudden formation of some islands which have been thrown up from the bottom of the sea, and several other facts, have brought back the old opinion that our globe was primitively in a state of incandescence; and there are, at this day, several philosophers who think that the earth is cooled only at the surface, that it is still in a state of incandescence in the interior, and that volcanoes communicate with this vast focus of heat. But whatever may be the opinion adopted as to the primitive condition of our globe, it cannot be doubted that it has sustained several successive modifications by fire and water. The hypothesis that the globe was at first in a state of incandescence, and that it has since sustained revolutions by the operations of water, is that which appears to me to accord best with various observed facts. The presence of arenes over a considerable extent of France, in places where no traces of extinct volcanoes are to be found, is an important circumstance for geologists. It is curious to see the study of hydraulic mortars furnish new arguments in favor of the theory of the *Vulcanists:* but, as often noticed, all the sciences have some points of contact.

The experiments that I shall give in the second section, on mortars made of fat lime and sand, and exposed to the air, will show how important it is to search after good arenes in the environs of our public works; because it is a means of procuring good mortars at a very cheap rate, and because it is the only means of procuring them cheaply, in countries where there are no hydraulic limes.

(TO BE CONTINUED.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Improvement in oil cans, or feeders. By A. C. Jones, Engineer.

In oiling machinery, especially Locomotive engines, great loss of oil arises from the can being upset or by falling. The improvement, shown in the margin, can be applied to the common can, by soldering a tube to its top which extends internally to within a short distance of the centre of the bottom. A small vent hole is made at the top of the can, to allow the air to escape when filling: it is obvious that the can may be turned bottom upwards, or on its side with a very small loss of oil compared with the old plan.

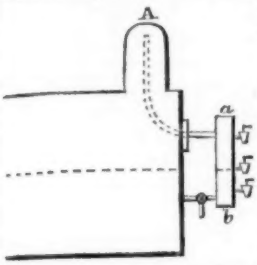
For the Journal of the Franklin Institute.

Water Gauge for high pressure Steam Boilers. By A. C. Jones, Engineer.

The object of this improvement is to find the correct height of the water in a boiler when it *foams.*

The apparatus consists of a tube or chamber *a, b* of the same metal as the boiler about 14 inches long and 2½ inches in the clear. Near the top and bottom a small pipe, or tube, of one-half inch bore is inserted to connect it with the boiler, the top branch being continued by a pipe within the boiler to the highest accessible point; the lower branch is connected below the lowest point at which the water can be worked, and has a cock

for the purpose of shutting off the communication with the boiler. Three gauge cocks are inserted in the front of the vertical chamber, *a*, *b*, at the same height as is customary on the old plan of operation. If the cock in the lower branch pipe is left open, the gauge cocks act in the same manner as if in the head of the boiler. If the boiler foams, the lower communication is cut off by the cock, the upper gauge cock is then opened, and if there is any water above it, the pressure of the steam on its surface forces it out to the level of the cock and no farther, and the length of time it takes to discharge the water, with a little practice gives the height of the water line above the cock; if no water is discharged from the upper cock it is shut, and a trial is made of the others, in succession.



The operation may be repeated by opening the communication with the boiler and allowing the water to rise to its level in the chamber.

I have tested this plan since its first invention (about three years since,) on locomotive, stationary, and steam-boat boilers; with decided success.

Bibliographical Notice.

The final report of the committee of the Philadelphia Medical Society, on the construction of instruments, and their mode of action, in the radical cure of Hernia, &c. By Heber Chase, M. D. Philadelphia, J. G. Auner, p. 243.

There are but few articles which are more frequently presented at the Patent Office as new and useful improvements, than Trusses for the cure of Hernia. A large number of these are but pretended improvements, presented by persons ignorant of what has been heretofore done upon this subject, or anxious only to obtain that species of sanction which the seal of the office is supposed to afford. The work, the title of which is given above, affords much information respecting the construction of such trusses as have been previously used, as well as of those which have been made the subject of a Patent by Dr. Chase; and as we have been supplied with the engravings used in the above work, we have deemed the subject suitable to our pages. One thing is certain, there is not any other point appertaining to our Medical or Surgical practice, in which so large a portion of our readers would be personally interested. Dr. Chase has obtained Letters Patent of the United States, for his trusses, under their various modifications, the nature of which are distinctly pointed out in the following review.

Those of our readers who are engaged in the practice of medicine, may recollect, that in consequence of the great importance of the subject, the Philadelphia Medical Society appointed a committee of Surgeons in the year 1834, with unlimited instructions to investigate the subject of hernia, together with the means employed for treating this disease. This laudable step was undertaken no doubt, in consequence of the numerous trusses of ephemeral existence which are yearly palmed upon the ignorant and unsuspecting, by impostors alleging their capability of curing hernia in all its forms;—a degree of pretension carrying with it the proof of its own fallacy. This committee made its preliminary report on the 5th and 12th of Decem-

ber, 1835, and the final report was read before the Society, and adopted on the 29th of April, 1837. The first of these reports was published in the American Journal of the Medical Sciences for February, 1836. The second, in the No. for August, 1837.

The speculative and theoretical views of the predecessors of the patentee, and of many of the profession, tending to show that a cure in hernia depended upon irritation produced by the instrument, and followed by "adhesive inflammation," was believed to be incorrect.

Doctor Chase, we think justly describes hernia, to be in a majority of cases, a dilation or enlargement of the natural aperture of the body, produced by a variety of causes. Proceeding upon this ground, his aim has been to construct his instruments upon Surgical and Anatomical principles; each instrument being adapted to one appropriate form of the disease only.

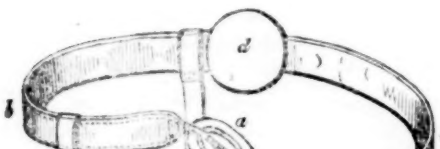
The instruments of Doctor Chase are five in number viz: The Inguinal —Ventro Inguinal—Femoral—Umbilical—and Double Trusses.

The report above referred to, contains 46 pages, 8mo. and is a model for this kind of essay: it is clear, unpretending, and profound, and is evidently the production of a meditative and reflective mind.

We will now give an epitome of the construction of the instruments, mode of application, and method of treatment.

Dr. Chase's Inguinal Truss, for common or simple Inguinal Hernia.

FIG. 1



a The block and block-attachment.

b The part of the spring which bears the greatest stress and requires the highest temper.

c The termination of the spring, made more flexible, and extending to the edge of the os ilium between the two spinous processes on the opposite side of the body.

d The back-pad seen in situ.

e The perineal strap with its end thrown round the extremity of the spring-cover. This figure represents the general outline of all the single instruments. Those peculiarities which render them applicable to the different kinds of rupture, remain to be noticed.

The perineal strap *e*, is always found attached to these instruments.

The dorsal pad, *d*, which is novel in its arrangement, consists of a circular disk of metal covered with buckskin. It is attached to the spring by a leathern loop, permitting it to be moved to either side at will. By this arrangement, the back and spine are relieved from that irritation and consequent inflammation which not unfrequently result from the pads of Hull and others, which are immovable, and which sometimes lay the foundation of serious diseases in those parts.

Chase's common Inguinal Block, with attachment.

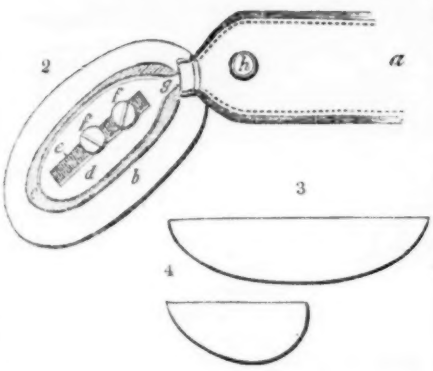


Fig. 2.—*a* The extremity of the main-spring of the truss.
b The block.
c The brass block-rider: the screws by which it is attached being covered by the block-slide.
d The block-slide.
e The window in the block-slide.
f f The two broad-headed screws of the block-adjustment, securing the rider to the slide, and, when loosened, sliding freely in the window.
g The soft iron flexible neck, attaching the block-slide to the main-spring.
h The button for the pelvic strap, which is generally used for the perineal strap also.

The proper perineal strap-button on the end of the block-slide is omitted in this and some succeeding figures, to prevent confusion.

Fig. 3—Longitudinal section of the block.

Fig. 4—Transverse section of the same.

The block *b*, of this instrument may be described as consisting of a longitudinal section of an oval spheroid, moulded by a force producing some flatness on one side. When applied, it extends from the pubic bone along the rout of the inguinal canal to a few lines above the internal ring, giving equal pressure and perfect security against the escape of the viscera throughout its whole extent. In this form of hernia we are advised the pressure should be made over the *internal abdominal ring*, extending as a further protection along the rout of the canal.

Having analyzed the several parts of the Inguinal Truss of Dr. Chase, the committee say that they felt bound honestly to state their conviction that this instrument surpasses all others known to them in the accuracy and permanence of its retentive power in common Inguinal Hernia; a conviction fully sustained by all their practical observations of the action of trusses. The instrument is worn with so much comfort, that patients generally relinquish it unwillingly, and have sometimes *absolutely refused so to do* even when pronounced well by the Surgeon.

The committee did not find themselves able to suggest any improvement, or to point out any defect of principle or construction in this truss as now employed by the inventor." See Rep. p. 555, Amer. Jour. Med. Soc.

Chase's Ventro-Inguinal block, with attachment.

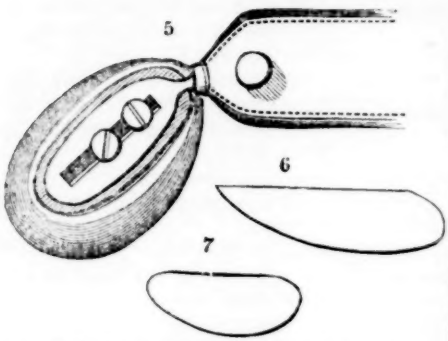


Fig. 5.—The attachment being in all respects similar to that in fig. 10, no references are required.

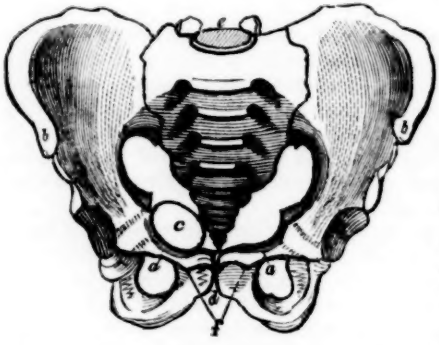
Fig. 6.—Longitudinal section of the block.

Fig. 7.—Transverse section.

The block of this instrument, resembles the common Inguinal truss-block, strongly compressed at its broader convexity, and made to overhang its base, so as to be adapted accurately to that part of the pubic bone over which the bowel passes in Ventro-Inguinal hernia.

In this variety of the disease, the pressure is given *over the external ring* and very near to the pubic bone. The following cut illustrates the position here taken.

Fig. 8.—*A view of the pelvis, with Chase' Ventro-Inguinal block in situ—to show the adaptation of its curvature to the form of the body and spine of the os pubis.*



a a The bodies of the pubic bones.
b b The anterior superior spinous processes of the ilia.
c The ventro-inguinal block in situ.
d The symphysis pubis.
e The base of the sacrum.
f The spines of the pubic bones.

The only part peculiar in this truss is the block; all the others are identical with the Inguinal Truss of Dr. Chase.

"The form of Chase's ventro-inguinal block is so accurately adapted to that of the os pubis, that it has secured the bowel perfectly in every instance of ventro-inguinal hernia in which it has been seen applied by the committee."

"To the complete instrument, as it has been actually employed by the inventor during the last year, the committee may safely apply the same language used in concluding their remarks on the Inguinal Truss."

Rep. p. 558. Op. Cit.

Chase's Femoral block with attachment.

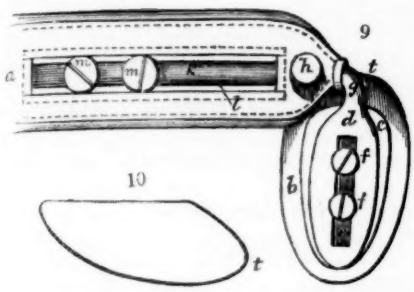


Fig. 9.—The letters from *a* to *h*, inclusive, have the same reference as in fig. 2.

k A window in the anterior extremity of the main-spring.

l The iron neck of the block-slide continued along the main-spring for some inches and seen through the window *k*.

m m Two broad-headed screws of the spring-adjustment, securing the flattened extremity of the iron neck to the main-spring, and, when loose, permitting it to slide on the main-spring.

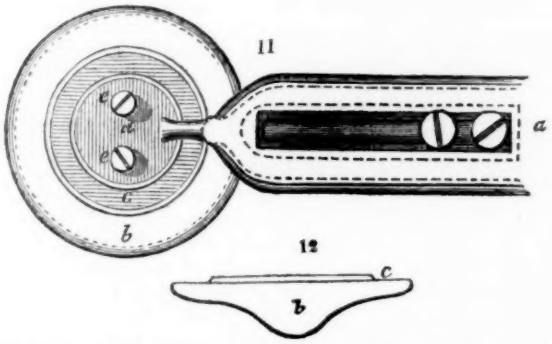
Fig. 10.—A longitudinal section of the femoral block.

The block of this instrument resembles a hen's egg held in a perpendicular position, with its larger end upwards, and flattened on one side, to which the block-rider (*c* fig. 9) is secured. Its pressure is made between the femoral vein and the os pubis, and over the site of the femoral ring; while the upper extremity (*t*) affords its pressure below Poupart's ligament.

This block has a double adjustment, one at (*f f*) enabling the surgeon to raise or depress the block at will, and a second, regulated by the screws (*m m*) to meet the peculiarities of individual pelves in regard to the distance between the wing of the ilium and the femoral ring. This double adjustment is undoubtedly novel, perfectly secure and accurate.

The spring of this instrument with its appendages, is similar to the instruments before described.

Fig. 11.—*Chase's Umbilical Block and Attachment.*



a The anterior end of the spring, with the same kind of spring-attachments as in the femoral truss.

b The circular block.

c The circular block-rider.

d The circular iron disk supporting the block-rider.

e e Two button-headed screws attaching the rider to the disk, and serving at the same time to secure the strap.

Fig. 12.—Section of the circular block.

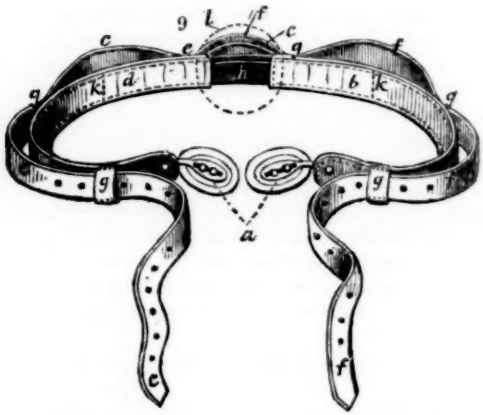
The novelty in this block consists in its central prominence, which may be raised on its convex face to any degree required. This prominence is a segment of a much smaller sphere than the margin of the block *b*. The central prominence is made broader or narrower, is more or less raised according as the case under treatment requires; and in employing the umbilical truss, the inventor is desirous of pressing back the ruptured or dilated parts, to the situation in which nature would have retained them, had union taken place at the umbilicus at birth.

The dorsal-pad of this instrument is oblong, and is attached to the spring by two loops.

Scapularies are sometimes used with this instrument.

Fig. 13.—*Chase's Double Truss—prepared for a double Inguinal Hernia.*

FIG. 13.



a The two common inguinal blocks with their attachments.

b The spring-cover of the left truss terminating in the strap *c c c c*.

c c c c The pelvic strap of the left truss, thrown into loops, and passing through an opening beneath the base of the attachment of the strap on the right side at *e*, like the flexor tendons of the last phalanx of the fingers through the terminations of those of the second phalanx.

d The spring-cover of the right truss terminating in the strap *f f f f*.

e The site of the commencement of the pelvic strap of the right truss, secured by the edges to the spring-cover, but permitting the left pelvic strap to pass up from under its base so as to become superficial in the rest of its course: this arrangement being concealed by the instrument.

f f f f The pelvic strap of the right truss thrown into loops.

g g g g g Loops confining each pelvic strap respectively to the spring-cover of the opposite truss.

h The two springs seen one behind the other, and naked, between the ends of the spring-cover.

k k Dotted lines representing the spots where the spring of each truss terminates within the spring-cover of its fellow.

l A dotted line representing the proper position for the back-pad.

Of all the various apparatus for the treatment of hernia, not one specimen exhibited so perfect a combination of springs and their appendages, or

embraced so complete an assemblage of mechanical advantages applied to the retention of hernia, as this instrument. The chairman of the committee in noticing this instrument, uses the following language. "Since the preliminary report was read, Dr. Chase has invented the admirable instrument now for the first time presented to the society. It is an association of two single trusses, so combined as to be perfectly independent in their action, without the slightest mutual interference, yet so associated by means of the straps and loose spring-covers, that they present the appearance, and act with all the convenience of a single instrument. Each spring, at its posterior extremity, re-enters the spring-cover of its fellow, and the strap of one truss passes smoothly through a passage beneath the commencement of that of the other, so that both sides appear symmetrical, as far as the springs and appendages are concerned, and the straps do not in the slightest degree embarrass each other. As the peculiarities of this instrument are confined to the spring-covers and straps, which are suited alike to the trusses for inguinal, ventro-inguinal, and femoral hernia, the instrument can be adapted at a moment's notice, to any possible combination of these three forms of the disease, so long as the varieties exist on opposite sides of the abdomen.

"The committee cannot speak too highly of this beautiful invention, but it may be safely permitted to speak for itself."

We have now reviewed in a cursory manner the instruments of Dr. Chase, and we only regret that the limits afforded, will not permit us to enter more fully into the subject. The cuts, however, of which we have availed ourselves in this instance, will in a great degree enable the reader to estimate the value of the improvements.

From a review of the whole subject as presented in the report, it may be fairly averred that Dr. Chase has closely studied the anatomy of hernia, that he has manifested great mechanical skill in the construction of his instruments, and that he is intimately acquainted with the action of trusses generally. Whether a set of instruments can be devised better calculated to fulfil all the indications required for the successful treatment of this very troublesome malady, may admit of much doubt; with our present knowledge of the disease, improvement seems scarcely desirable.

The patentee's claims, making a part of the specification of his patent, are as follows:—

"Notwithstanding that I have in the preceding specification set forth by an exact description the instruments as used by me in the cure of the different kinds of hernia, and have given particular admeasurements for springs, blocks or pads, &c.; still I wish to be particularly understood that in all cases of hernia I vary my treatment in relation to the size of instruments, agreeably to the age of the patient and state of the case, governing myself according to existing circumstances, but at all times adhering to the principles set forth in this specification. In my apparatus, and the several instruments of which it is composed, the pads or blocks are adapted to the several varieties of hernia with due and strict attention to the anatomical and physiological peculiarities of the parts interested in the several varieties of the disease, the said pads or blocks being so constructed and attached as to secure the permanent and certain retention of the bowel in all cases which admit of retention by mechanical means, thus allowing the powers of nature, if possible, to close the orifice by which the bowel escapes from the cavity of the abdomen in this disease, which result is not obtained with certainty by any other instruments previously invented.

"I claim the peculiar mode of attachment for the block, as given in the

description of each instrument, including the block-slide adjustment of the inguinal and ventro-inguinal trusses, and the block-slide adjustment, and the spring adjustment of the femoral truss, and spring adjustment with the permanent block attachment of the umbilical truss.

"I claim also the new method of employing dorsal pads in all the trusses, by which method the said pads are made movable, so as to slide to any distance which may be required.

"I claim the peculiar double truss herein described, namely, the employment of two springs sliding upon each other with pads or blocks attached and combined in such a manner as to act like one entire instrument, by whatever arrangement of the springs and straps such a result may be obtained.

"Lastly, I claim the several improvements which have been described and specifically claimed independently of the material of which they may be constructed, and whatever alterations in form or size they may hereafter undergo, so that similar effects are produced by analogous means.

"For a further illustration of the peculiarities, and construction, and form, upon which the operation of the foregoing instruments are dependent, I refer to the drawings with written references thereto, deposited by me in the patent office, in compliance with the requirements of the patent law."

The committee thus conclude their remarks upon the instruments of Dr. Chase:—

"After all that has been stated, the committee feel themselves fully warranted in the following conclusions.

"1. The retentive power of solid blocks is, *cæteris paribus*, superior to that of soft pads in the treatment of hernia, as has been already stated in the Preliminary Report.

"2. The chances of radical cure depend upon the perfection and permanence of the retention.

"The perfection and permanence of the retention depend—first, upon the mechanical action of the instruments; and, secondly, upon the power of the parts affected to bear that action without danger of physiological accidents of sufficient importance to interfere with the treatment.

"4. All the instruments with solid blocks contrived before the recent inventions of Dr. Chase, are decidedly liable to important mechanical objections, and all of them, with the exception of the Rachet truss, are moreover capable of producing physiological accidents of sufficient importance to interfere with the treatment.

"5. The construction of the Rachet truss is such as to render retention uncertain, even in ventro-inguinal hernia, to which form of the disease alone, it is tolerably will adapted.

"6. The instruments of Dr. Chase have effected the permanent and accurate retention of the intestines in every case of hernia observed by the committee, without material inconvenience to the patient, and often under trials more severe than are usually ventured upon by those who wear other trusses; trials which would be imprudent with any other apparatus known to the committee.

"7. If we except the femoral truss, these instruments have stood the test of much practical application, without superinducing any physiological accidents of sufficient importance to interfere with the treatment.

"8. The mechanical principles upon which the femoral truss is constructed, appear highly ingenious and promising; and unless this instru-

ment should be found hereafter to be productive of important physiological accidents, it must take precedence of all other modes of treating this variety of the disease. No such accidents are yet known to have been produced by its employment; but the committee have not enjoyed the opportunity of personal inspection in a sufficient number of cases to determine general results, nor do they deem it proper to receive evidence from any other quarter in discharging the trust reposed in them by the society.

"The committee are induced, by the foregoing conclusions, to recommend in strong terms, the instruments of Dr. Chase to the confidence of the profession, as the best known means of mechanical retention in hernia, and as furnishing the highest chances of radical cure."

Franklin Institute.

Annual Meeting.

The Annual Meeting of the Institute was held at their Hall, on Thursday evening, January 18th, 1838.

James Ronaldson, Esq., President, in the chair.

Solomon Roberts, Esq., Recording Secretary, pro. tem.

The minutes of the last Quarterly Meeting were read and approved.

Donations of books were received from the Zoological Society of London; the Royal Geographical Society of London; Mr. John Gummere, of Haverford, Pa.; Mr. Samuel Colman, of New York; and A. L. Elwyn, M. D., R. Bridges, M. D., Heber Chase, M. D., and Mr. Robert Davis, of Philadelphia.

The Actuary laid on the tables the periodicals received during the past quarter in exchange for the Journal of the Institute.

The Annual report of the Board of Managers was read, and, on motion, was accepted, and referred to the Committee on Publications.

The Treasurer presented his report of the funds for the last quarter, and also a statement for the year ending December 31st, 1837—which were read and accepted.

The Committee on Publications presented their report on the operations of the Journal of the Institute for the year ending December 31st, 1837, which was read and accepted.

Mr. John Horton, from the Committee of Tellers of the election for officers and managers of the Institute for the ensuing year, (appointed at the preparatory meeting this day,) presented their report of the result of the election, when the President declared the following gentlemen as duly elected:

James Ronaldson, President.

Isaiah Lukens, Thomas Fletcher, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Isaac Hays, M. D., Corresponding Secretary.

Frederick Fraley, Treasurer.

Managers.

Samuel V. Merrick,	John C. Cresson,
Abraham Miller,	James M. Linnard,
William H. Keating,	Andrew M. Eastwick,
John Struthers,	Isaac P. Morris,
Matthias W. Baldwin,	Charles B. Trego,
Alex. Dallas Bache,	Henry Troth,
Jas. Henry Buckley,	John S. Warner,
Alexander Ferguson,	William H. Carr,
John Agnew,	*Robert M. Patterson,
John Wiegand,	*Henry D. Rogers,
Alexander M'Clurg,	*John Gilder,
Samuel Hufty,	*William D. Parrish.

(Extract from the minutes.)

JAMES RONALDSON, *President.*

SOLOMON W. ROBERTS, *Rec. Sec. P. T.*

Fourteenth Annual Report of the Board of Managers of the Franklin Institute.

On the return of the period which terminates their official career, the Managers of the Franklin Institute present to their fellow members their Fourteenth Annual Report.

It is with sentiments of unalloyed satisfaction, that the managers feel themselves authorized on this occasion, to renew their congratulations upon the continued success which has attended the labours of the Institute, in its useful and unpretending career.

Notwithstanding the temporary cloud, which has cast so deep a shadow over our recent manufacturing prosperity, the Institute has continued to receive the undiminished support of its members; and has, in return, imparted to them its accustomed, varied, gifts of knowledge, by means of its lectures and drawing school, its library and cabinets of minerals and models, by the social and informal interchange of opinion and experience at the Monthly Conversation Meetings, and by the valuable fund of practical and scientific information, spread upon the pages of its Journal.

Nor have its benefits been diffused only within the circle of its own members, widely as that circle is now extended.

The Committee on Science and the Arts, have maintained their zeal and activity, with no other incitement than the love of doing good; and will have contributed no small share of disinterested exertion to the common weal.

Number of new subjects brought before the Committee		37
Do.	lying over from last year - - -	8
		45
Do.	disposed of by report or otherwise -	41
Do.	remaining for future action - -	4

The Committee on Explosions of Steam Boilers, after a laborious investigation, continued during four successive years, have completed the task assigned to them; and their reports to the government of the United States

*New members.

have furnished a fund of valuable materials, which may constitute the basis of patriotic and wise legislation for the protection of the lives and property of our citizens.

The Committee on Weights and Measures, after reporting to the legislature of this state, a projeét of laws for ensuring a uniform system, have been engaged in maturing the plan for carrying the law into effect; and are now prepared to verify the standards of weights and measures, whenever the requisite authority shall be delegated to them by the Executive.

In the early part of last year, the Board decided that it was inexpedient to hold the usual exhibitions of American manufactures, on the return of the biennial period in the autumn of 1837. Although this decision was not founded upon any anticipation of the general paralysis of business, which has since occurred; an additional cause for approval of their course is found in the almost total cessation of manufacturing operations, attending the commercial derangements. As some comment has been made upon the temporary discontinuance of our exhibitions; and the supposition has been entertained, that the omission last year arose from a want of zeal on the part of our members, the Board deem it but just, to lay before the Institute the views on which their decision was founded; leaving it to their successors to determine how far these views shall continue to influence their future course.

At the time when the Franklin Institute first started into existence, the manufactures of Philadelphia, and indeed of the whole Union, were in a condition of weak and destitute infancy. The mechanics of the country were unaided by the enlightening influence of science; and had not yet learned to avail themselves of that great lever of social prosperity, the systematic and free interchange of ideas, and co-operation of interests.

The primary object, therefore, of the Institute at this period, was, to effect an extensive and intimate acquaintance between the various classes of manufacturers, and likewise between the producer and the consumer.

A rapid series of improvements in the arts, partly the cause, and partly the effect, of the exertions of the Institute, called for the frequent repetition of exhibitions, designed to keep the public mind informed of the progress of our domestic industry.

But that state of infantile weakness, and of rapid change, has now in a great measure passed away; and the more mature and steady growth of the arts, does not require, and would not repay the labour of such frequent displays. They were originated with a view to the benefit of the community, and should be continued no longer than the interests of society require. The energies of the institute have become too valuable to be expended in getting up a mere idle pageant.

It is believed, however, that exhibitions of domestic manufactures, of a character worthy the true friends of the arts, might be held at periods of four or five years; which would allow a sufficient lapse of time for the development of important and interesting improvements; and would thus retain their character of novelty and usefulness.

Although any self gratulation on the subject at this time may seem premature, the Board cannot close their report without expressing their sanguine hopes, of the speedy development of a feature of the Institute, which has been warmly cherished in prospect from the earliest days of the society. In their first annual report, the Managers of the Institute suggested the establishment of a school of arts, in which the mechanic, the manufacturer, the miner, and the civil engineer, might receive instruction in all the sciences which have a practical bearing upon their several pursuits; and from that

period the Institute has been anxiously looking forward to the time when public opinion should be sufficiently awakened to the vast importance and utility of such an institution.

It is confidently believed that the time has now arrived, in which enlightened legislation, on a subject so deeply interesting to the community at large, and to the mining, manufacturing, and agricultural population of our own state in particular, will be sustained by acclamation, from one extremity of the commonwealth to the other.

There has, probably, never been any public measure pressed upon the attention of our legislature, which has met with more cordial and unanimous approval, from men of all parties and all conditions in society. The conviction being universally entertained, that the claims of the productive classes of the community, upon legislative munificence, are strong and imperative.

The Committee on the Chesnut Street Hall, have effected some further sales of the loan during the year; but have not yet disposed of a sufficient amount to warrant them in carrying into effect the improvements necessary to fit the building for the purposes of the Institute. The property at the present time yields an income beyond the interest on its cost, and there is no reason to doubt that it will continue equally productive until more auspicious times shall enable them to complete the intended alterations, and thus increase the accommodations of the Institute to the extent which its large list of members requires.

During the past year the Institute has elected 188 new members. 93 have been lost by resignation, and 23 by death. Increase during the year 72. Whole number of members 2078.

The following named gentlemen have become life members: Messrs. J. J. Barras, Thos. Earp, Davis Henderson, Jno. K. Kane, Wm. McIlvaine, Israel Morris, Wm. S. Otis, Solomon W. Roberts, Return Sheble, Thos. S. Stewart and Jos. Saxton.

JOHN STRUTHERS, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

Report on Prof. Morse's Electro-Magnetic Telegraph.

THE COMMITTEE ON SCIENCE AND THE ARTS constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an Electro Magnetic Telegraph invented by Professor F. B. Morse, of the city of New York, REPORT,

That this instrument was exhibited to them in the Hall of the Institute, and every opportunity given by Mr. Morse and his associate Mr. Alfred Vail, to examine it carefully, and to judge of its operation; and they now present the following as the result of their observations.

The instrument may be briefly described as follows:

1st. There is a galvanic battery of sixty pairs of plates, seven by eight and a half inches each, arranged according to the very convenient plan devised by Prof. Hare, and set in action by a solution of sulphate of copper.

2d. The poles of this battery can be connected, at pleasure, with a circuit of copper wire, which, in the experiments we witnessed, was ten miles in length. The greater part of the wire was wound round two cylinders, and the coils insulated from one another, by being covered with cotton thread.

3d. In the middle of this circuit of wire,—that is at what was considered

virtually a distance of five miles from the battery, was the *register*. In this there is an electro-magnet, made of a bar of soft iron bent in the form of a horse-shoe, and surrounded by coils of the wire which forms the circuit. The *keeper* of this magnet is at the short arm of a bent lever, at the end of the longer arm of which is a fountain-pen. When the keeper is drawn against the magnet, the pen comes in contact with a roll of paper wound around a cylinder, and makes a mark with ink upon this paper. While the telegraph is in operation, the cylinder which carries the paper, is made to revolve slowly upon its axis, by an apparatus like the kitchen jack, and is at the same time moved forward so that the pen if constantly in contact with the paper would describe a spiral or helix upon its surface.

4th. Near the battery, at one of the stations, there is an interruption in the circuit, the ends of the separated wire entering into two cups, near to each other, containing mercury. Now if a small piece of bent wire be introduced, with an end in each cup, the circuit will be completed, the electro-magnet at the other station will be set in action, the keeper will be drawn against it, and the pen will make a mark upon the revolving paper. On the other hand, when the bent wire is removed from the cups, the circuit will be interrupted, the electro-magnet will instantly cease to act, the keeper will, by its weight, recede a small distance from the magnet, the other end of the lever will rise and lift the pen from the paper, and the marking will cease.

5th. The successive connexions and interruptions of the circuit, are executed by means of an ingenious contrivance for depressing the arch of copper wire into the cups of mercury, and raising it out of them. This apparatus could not be described intelligibly without a figure; but its action was simple, and very satisfactory.

6th. Two systems of signals were exhibited, one representing numbers, the other letters. The numbers consist of nothing more than dots made on the paper, with suitable spaces intervening. Thus ... . would represent 325, and may either indicate this number itself, or a word in a dictionary, prepared for the purpose, to which this number is attached. The alphabetical signals are made up of combinations of dots and of lines of different lengths.

There are several subsidiary parts of this telegraph which the committee have not thought it necessary to mention particularly. Among these is the use of a second electro-magnet at the register, to give warning by the ringing of a bell, and to set in motion the apparatus for turning the cylinder.

The operation of the telegraph, as exhibited to us, was very satisfactory. The power given to the magnet at the register, through a length of wire of ten miles, was abundantly sufficient for the movements required to mark the signals. The communication of this power was instantaneous. The time required to make the signals was as short, at least, as that necessary in the ordinary telegraphs. It appears to the committee, therefore, that the possibility of using telegraphs upon this plan, in actual practice, is not to be doubted; though difficulties may be anticipated which could not be tested by the trials made with the model.

One of these relates to the insulation and protection of the wires, which are to pass over many miles of distance, to form the circuits between the stations. Mr. Morse has proposed several plans,—the last being to cover the wires with cotton thread, then varnish them thickly with gum-elastic, and enclose the whole in leaden tubes. More practical and economical

means will probably be devised; but the fact is not to be concealed that any effectual plan must be very expensive.

Doubts have been raised as to the distance to which the electricity of an ordinary battery can be made efficient; but the committee think that no serious difficulty is to be anticipated as to this point. The experiment with the wire wound in a coil may not, indeed, be deemed conclusive; but one of the members of the committee assisted in an experiment in which a magnet was very sensibly effected by a battery of a single pair through an insulated wire of 2¼ miles in length, of which the folds were four inches apart; and when a battery of ten pairs was used, water was freely decomposed. An experiment is said to have been made with success, on the Birmingham and Manchester rail-road, through a circuit of thirty miles in length.

It may be proper to state that the idea of using electro-magnetism for telegraphic purposes has presented itself to several different individuals, and that it may be difficult to settle among them the question of originality.

The celebrated Gauss has a telegraph of this kind in actual operation, for communicating signals between the University at Gottingen and his magnetic observatory in its vicinity. Mr. Wheatstone of London, has been for some time also engaged in experiments on an electro-magnetic telegraph. But the plan of Professor Morse is, so far as the committee are informed, entirely different from any of those devised by other individuals, all of which act by giving different *directions* to magnetic needles, and would therefore require several circuits of wires between all the stations.

In conclusion the committee beg to state their high gratification with the exhibition of Prof. Morse's telegraph, and their hope that means may be given to him to subject it to the test of an actual experiment made between stations at a considerable distance from each other. The advantages which this telegraph would present, if successful, over every kind heretofore used, make it worthy of the patronage of the government. These are, that the stations may be at a distance asunder far exceeding that to which all other telegraphs are limited,--and that the signals may be given at night and in rains, snow, and fogs, when other telegraphs fail.

(By order of the Committee.) WILLIAM HAMILTON, *Actuary.*

Philadelphia, February 8th, 1838.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY 1837.

With Remarks and Exemplifications by the Editor.

82. For *a Turning Table for rail-roads*; Jeremiah Myers, Attleborough, Bristol county, Massachusetts, May 8.

There is to be a revolving platform constructed much in the usual way, but it is to be placed upon a carriage with rollers running upon a rail over the pit prepared for the turnabout, which pit may be two or three times as long as it is wide, or as the diameter of the turnabout, which may be drawn along it by means of a chain and windlass. The ends of the pit are circular, and the turning table is to be moved round by a pinion taking into teeth on its lower side.

"The invention claimed consists in placing the revolving circular platform, or turning table, upon a carriage moving upon rails; in making an oblong pit by which the locomotive engines or cars may be run off the turning table at right angles from any part of the pit; and from

either end obliquely as well as at right angles, or otherwise, to any part of the work-shop, depot, carriage-house, or other place; and in the facility afforded from the above described form of the pit, of clearing the turning table from snow, ice, or other obstructions: likewise in placing the locomotive engine on a car upon a carriage running at right angles with the track, by which means the locomotive or car may be run off upon any other track parallel with the same. A revolving circular platform, or turning table, is not claimed, but only the method of turning it by the use or application of a circular rack and pinion turned by a crank."

Possibly such a contrivance as the foregoing may be found useful in a workshop, or depot, but it is not likely that it will be applied elsewhere. The latter claim to the circular rack and pinion would scarcely be sustainable; and some of the former claims are to results instead of to the means by which they are produced.

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83. For an *Iron Chest, or Safe*, for the preservation of Books; Benjamin Sherwood, city of New York, May 8.

This chest, safe or bookcase, is to be made in the form of a vertical cylinder. Its security is to result from there being two double cases each filled with a bad conductor of heat. The outer case is a double cylinder, with double heads, a space of about two inches between the two being filled with a mixture of prepared Plaster-of-Paris, and pulverized charcoal. The inner case is similarly made, there being a space of about an inch between it and the outer; it revolves on central gudgeons, has its proper door, which when closed is to be turned round so as to be on the side opposite to that of the outer case.

The claim is to "the principle of suspending by pivots, one safe within another, that the door of the inner one may be shut, and it turned round and secured so as to place the door of the inner and outer safes in different directions from each other; that if by a fall of any great weight upon it the outer door should be thrown open, the inner one being turned round would prevent any exposure of the contents: second, the application of pulverized charcoal and boiled gypsum combined, in fire proof chests, as a non-conductor of heat.

Double chests failed in the intense heat of the fire in New York, and there does not appear to be any thing special in that presented to us above, to protect it under similar circumstances; the mixture of charcoal and gypsum will do no more good than charcoal alone, or various other bad conductors of heat, or, in fact, than a mere air chamber.

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84. For a machine for *Facing and Dressing Stone;* David Hull and John Critcherson, Portland, Cumberland county, Maine, May 8.

The cutting is to be effected by chisels, or cutters, projecting out from a quadrant of a cylinder, which is to be vibrated backward and forward above the stone, being caused to do so by the action of a crank shaft, and fly wheel. The cutters are to be forked, so as to have two edges, and it is said that they will sharpen themselves by their vibratory motion. Perhaps they may, but to us the motion seems well calculated to produce a contrary effect. The claim is to "the double edged cutters placed upon a segment of a cylinder, having a pendulous mo-

tion, for cutting and dressing stone, substantially as set forth in the specification."

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85. For a machine for *Cutting and Dressing Granite, Marble, or other Stone*; John D. Buzzell, Cape Elizabeth, Cumberland county, Maine; first patented June 2d, 1836, re-issued on an amended specification, May 15.

The description of this machine is of great length, referring throughout to accompanying drawings. The claims made are to "the particular arrangement and combination of the cutting and polishing cylinders; the chisels or cutters used for cutting, grooving, beading; the method of raising and regulating the material to be operated upon, and the arrangement of the machinery for revolving and moving the cylinders, and moving the carriage."

The chisels for cutting, adapted in shape to the particular purpose for which they are to be used, are fixed in sockets set in spiral rows round a hollow cast iron cylinder, and these, it is said, are to "strike upon the stone in such a manner as to cut the stone and dress and polish it fit for building." The peculiar form of the chisel is described, and is such that it may be shifted in its socket as it wears, and so secured as to present a new cutting edge. There are to be cylinders of stone for grinding and polishing after the cutting; and a wooden cylinder covered with leather, to be used with emery, &c., for the same purpose. How far some of the things claimed may be sustainable, we are not prepared to say; we allude to such as the method of raising and regulating the material. We have not seen this machine in operation, but from those who have we have received very favourable reports. We look for one to be brought to Washington, to be tried on stone for the public buildings.

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86. For improvements in the *Air Pump for Low Pressure Steam Engines;* Thomas B. Silliman, city of New York, May 15. (See specification.)

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87. For an improved mode of *Running Saw Mill Gates upon Irons;* Henry Johnson and Nelson Johnson, Erwin, Steuben county, New York, May 15.

This patent is taken for a trifling alteration in the mode of constructing slides, or guides, of metal, for a saw gate; the claim made is to what is denominated a "spring wedge, for pressing up the box against the slide." This particular contrivance it is not considered worth while to describe, as the making a good slide is a thing of no difficulty whatever.

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88. For a machine for *Cutting, Grinding, and Polishing Granite, Marble, and other kinds of Stone;* Mighill Nutting, Portland, Cumberland county, Maine, May 15.

The patentee says, "I claim as my invention, the hemispherical nuts, as arranged, for raising, and regulating the height of the stone to be cut, ground, or polished. I also claim the particular manner in which I have arranged the springs above the hammers, and those which sustain the chisels upon shafts, by means of which they can be simultaneously

raised and lowered. I also claim the manner in which I have arranged and combined the respective parts of the cutter frame, so that the position of the chisels, and of the other parts connected therewith, may be regulated by the turning of the cutter frame upon its axis; and the manner of vibrating this frame by a lateral motion communicated to the said axis."

The hemispherical nuts are set into concave beds, on which they have free motion, so that the screws which are used to regulate the height of the stone, may always turn without binding. The cutters are raised by means of lifters on a revolving shaft, and are so fixed as that the feed of the whole of them may be regulated simultaneously. The chisels are raised to a given height, by means of springs, which are also capable of simultaneous regulation.

The subject of stone cutting machines has arrested the attention of several different inventors within a short period of time, most probably in consequence of the very favorable reports of the success of the machine invented and patented by Mr. Hunter, of Scotland.

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89. For a *Machine for Cutting Grass and Grain;* Alexander M. Wilson, Rhinebeck, Dutchess county, New York.

This is a renewed patent, issued in consequence of the destruction of the original by fire, at the time the patent office was burnt. This patent was noticed at p. 48, vol. xviii. There appears to be some discrepancy between the claims made in the original patent, as there stated, and those in the renewed instrument. The following are the words of the claim as now presented. "What I claim as my invention in the foregoing machine, is the construction of what I call the gathering wheel, with its offsets, made in the way described, and having knives or cutters attached to its lower side; the whole formed and operating substantially in the manner herein set forth."

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90. For improvements in the *Machine for cutting Grass and Grain;* Alexander M. Wilson, Rhinebeck, Dutchess county New York, May 15.

The claim under this patent for an improvement on that last noticed, embraces a sliding gear above the gathering wheel, in combination with a hinge guard plate under the front edge of the wheel, and the clutch box upon the shaft, to allow of the adaptation of the knives and gathering wheel to uneven ground; and also to the manner of balancing the machine.

A machine very similar to this, in appearance, is shown in Loudon's Encyclopedia of Agriculture, p. 422, third edition. The gathering wheel and knives, however, are circular, instead of having breaks, as in Mr. Wilson's. We believe that the difficulties which presented themselves in the Scotch machine have not been removed; there appears to be too much complexity in the instrument itself, and a considerable waste of power in moving the gathering wheel and its load, where the crop is heavy.

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91. For *Boats for Canals, Bays, &c.;* Abraham Morrison, Johnstown, Cambria county, Pennsylvania, May 15. (See specification.)

92. For a new and improved *Mode of Propelling Boats;* Jesse Ong, North Huntingdon, Westmoreland county, Pennsylvania, May 23.

The claim is to "the application of two paddle wheels for the purpose of propelling boats, at the centre of the stern, and having that centre as the common focus of their motions, which are contrary in direction, and their planes at right angles instead of parallel with the direction of the boat, and the direction and order of their strike is such that the created currents, whilst they assist the efficacy of the wheel, are themselves dissipated and destroyed by their successive action on each other."

The paddles are set obliquely to the hub, or centre, of the propelling wheels, which are parallel to, and in the vicinity of, each other. The shaft of one wheel is hollow, to allow that of the other to pass through it, as they are to be propelled in reverse directions, the obliquity of the paddles being reversed.

Attempts have been made to propel boats by means of wheels like the foregoing, but, we believe, on separate axes. How far the reversed force acting upon the water will still the agitation, we are not prepared to say; this must be determined by experience; we, however, do not believe that it will be such as to have much effect in preventing the washing of the banks of canals; the only situation where such an affair is of importance.

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93. For a *Steam Regulator to prevent Explosions in Boilers;* Augustus Eitelgeorge, Cincinnati, Hamilton county, Ohio, May 23.

A boiler is to be made in any of the usual forms, and a second vessel is to be made of the same form, but less in its dimensions, so that when placed within the first there shall be a space of four or five inches between them; the inner vessel, which is called a steam regulator, is to be perforated with numerous holes over its whole surface.

The claim is to "the application to common steam boilers of a perforated steam regulator, of a figure correspondent to that of the boiler in which it is placed, but of smaller dimensions, leaving a space between it and the sides and ends of the boiler, secured by rods or arms extending from the sides and ends of the regulator to the sides and ends of the boiler; the flues passing through both regulator and boiler, for preventing the bursting of the latter, by checking, breaking, or equally distributing, the power of the steam, and thus preventing its acting with too great a force on any part of the boiler."

So far as we remember, this mode of preventing explosions has not been hitherto essayed, and so far as we are able to judge upon such a subject, it never will be essayed by any one who understands any thing of the nature of steam, and who is acquainted with the vast power which has been manifested in most of the explosions which have occurred. We really think that a patent might have been fairly refused on account of the trifling nature of the contrivance; but this ground, when taken, is one of the most offensive to those who imagine that they have made great discoveries. If the thing claimed can be pointed to as having been previously done, this is considered as a mere misfortune; but to call any contrivance worthless which some one has thought worthy of a patent, is an act of the most monstrous injustice, and can arise only from ignorance or interest, or from a combination of the two.

94. For an improvement in the *Construction of Water Wheels;* Nehemiah P. Stanton, Syracuse, Onondagua county, New York, May 23.

Some variations in the mode of constructing this wheel are described, but, in general, it is to be made by forming spiral wings, or floats, on the two ends of a horizontal shaft, and covering these with a tight drum or case. The outer ends of the drums, are enclosed, there being perforations on their peripheries close to the heads, through which the water is to escape from the spirals. The shaft which connects these two wheels passes through an opening at the lower end of a trunk, or floom, against the sides of which the open ends of the drums fit and revolve, and through which they receive their water. The invention claimed, "is the conducting of the diagonal or spiral tapering buckets, with the discharge of the water in the extreme surface of the wheel, or at the point of greatest length of lever."

This contrivance adds another to the catalogue of what are called reaction water wheels. It has some claim to novelty in its form, but it would not be an easy task to tell in what way this variation of form will render it a substantial improvement.

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95. For an improved *Rail for Railways;* John Ruggles, Thomaston, Lincoln county, Maine, May 23. (See specification.)

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96. For an improvement in *Fire Arms and Ordnance;* Henry C. Fay, Lancaster, Worcester county, Massachusetts, May 23.

In this instrument the barrel is connected to the stock by pivots, or trunnions, forming a hinge joint; and when the piece is to be loaded, a spring catch which holds them in place is pressed down, and the barrel depressed, so as to expose the open end of the breech, into which a ready charged metallic tube, or cartouche, is to be inserted, having on its back end a percussion cap.

By the act of loading, above described, the trigger is to be thrown out, and other movements made, preparatory to the discharge of the piece. The claims are of greater length than we think it necessary to transcribe, as they refer to certain peculiarities of structure upon which the patentee must depend for the maintenance of his right, which, however, is not, we think, very likely to be controverted, if controversy is at all dependant upon the actual use of the invention.

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97. For a new mode of *Applying Water to Tub Wheels;* David B. Napier, Liberty, Casey county, Kentucky, May 23.

The claim made is to "the application of water to tub mill wheels by two shoots, through a block or blocks, graduated so as to keep the column of water solid, and acting upon the wheel by pressure; also the band to prevent the escape of water." The two shoots deliver the water at opposite points, and each is to extend one third of the way round the wheel. Particular calculations are furnished for the exact proportions of the various parts, but still there is a want of clearness in the description, which the drawing does not entirely remove.

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98. For an improvement in *Stoves;* Ethan A. Andrews, Boston, Massachusetts, May 30.

We are told that the "invention consists in a part called the *radiator,*

which is placed behind the stove, and which may be attached to all kinds of stoves, whether close or open, whatever be the fuel used in them, provided the smoke and gases are carried from them by pipes."

The radiator is formed by two plates of metal an inch or more apart, enclosed at the edges, and it is placed at the back of the stove. Its appearance being something like that of a chimney board, but is to stand out from the fire place, or wall, so that both its sides may be exposed. A pipe leads into it from the back of the stove, and may, when desired, pass directly thence into a chimney, but by closing a valve the draught is made, by means of partitions, to circulate up and down between the two plates of the radiator, whence it escapes through two other pipes into the chimney. The radiator is in effect, therefore, a flattened pipe, or flue, for the distribution of heat. The claim is to "the combination of the stove radiator with its partitions and flues, constructed in the manner and for the purposes described."

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99. For a machine for *Drying Oil Cloths, Painted Floor Cloths, &c.;* Daniel Sampson, Winthrop, Kennebec county, Maine, May 30. (See specification.)

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100. For an *Apparatus to be used in Pointing Cannon;* John Hobday, Portsmouth, Norfolk county, Virginia, May 30.

The general construction of this apparatus is made known with sufficient clearness in the claim, as follows:

"What I claim as my invention, and wish to secure by letters patent, is the constructing of an instrument for the pointing of cannon, which instrument has an index pointing horizontally, or indicating the horizontal position and inclination of the gun to which it is attached; the position of the index being preserved by the action of a pendulous weight to which it is attached."

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101. For an improvement in the art of manufacturing *Cast Iron Cannon;* Cyrus Alger, Boston, Massachusetts, May 30. The specification of this patent will be published in an early number of this Journal.

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102. For a new mode of *Manufacturing Saddle Trees;* William Kelly, White Deer township, Union county, Pennsylvania, May 30. (See specification.)

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103. For a machine for *Hulling and Scouring Rice;* Charles K. Harvey and Erastus Tracy, Poughkeepsie, Dutchess county, New York, May 30.

This machine is constructed something like a grist mill, but instead of stones, a bed and runner of peculiar construction are employed; the lower disk forms the runner, the upper an inverted bed. The inverted bed which has a rim an inch and a half deep, is to be stuffed with curled hair, and over this is to be a covering of strong canvass, with No. 3 emery glued upon it. This is used for hulling; but when the hulled rice is to be scoured, a bed covered with lamb's skin felt, sheared so as to leave the wool three fourths of an inch long, is to be substituted.

The runner is to be constructed like the inverted bed, being, for hulling, covered with No. 3, emery, but for scouring, with emery No. 0.

The claims are to, "*First*, The particular manner of constructing the elastic bed and runner, by the use of curled hair. *Second*, The construction of the inverted bed. *Third*, The particular manner of introducing the grain between the working fans by the convex form of the runner, as shown in the drawing. *Fourth*, The particular arrangement and combination of the different parts, many of which are old, but taken together, present a new arrangement of a machine."

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104. For an improved *Cooking and Heating Stove;* Washington Auld, and James Cox, City of Philadelphia, May 30.

The claims refer to parts described in a specification of considerable length, without which, and the drawings, they would not be understood. The apparatus appears to be skillfully arranged, and we would willingly make it fully known; should the patentees hereafter furnish the necessary cuts, we will insert the specification. This we are ready to do whenever so furnished with the means.

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105. For an improvement in the *Spiral Bucket Water Wheel;* Joseph C. Green, Fayette, Kennebec county, Maine, May 30.

This water wheel consists of a cylinder grooved from end to end, like a many threaded screw, which cylinder is to be enclosed in a hollow case, or tube, which fits it as closely as may be, but within which it is to revolve; one end of the case is to have a close fitting head, and at the other, where the water is to be discharged, the head may be removed to a greater or less distance by appropriate means, and is called a ventilator. The water is, in general, to be admitted through an opening in the middle of the case, and under pressure of the head. The claims are to "The giving of the grooves or vanes of the wheel a greater obliquity at the discharging than at the receiving point. The use of a head to the cylinder to confine the pressure of the water; and the use of a ventilator regulating the discharge of the water."

We are really at a loss, after reading the specification, and examining the drawing with some care, to perceive in what the merits of the apparatus consist. We find something of novelty, but must wait to learn the amount of utility, and really apprehend that this will prove a minus quantity.

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106. For a machine for *Cleaning, Winnowing, and Separating Grain;* Markwell Thomas, Alfred, York county, Maine, May 30.

The claim in this machine is to "the employment of iron circular plates, which are bound in place by iron rods, by which the cylinders are made strong. The leaving a space between the upper and lower ends of said cylinders, and inserting in the shoulders of the inner cylinder, the iron sweeps as shown in the drawing, by which the grain is prevented from entering the joints, and the machine kept free. The employment of a spiral plate, and the mode of arranging the same by which its upper surface is left smooth and uninterrupted by fastenings. The adding a middle sieve by which the withered, defective, or imperfect grain is separated from the full and perfect grain. The double spout with doors by which the smaller or larger grain, the perfect or

imperfect of any one kind of grain, may be let into, or kept out of, the cylinder at pleasure.

It will be apparent from the foregoing, that the drawings are essential to the understanding of the particular structure of this machine.

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107. For an improvement in the mode of manufacturing *Splints for Friction Matches;* Stephen Dale, Concord, New Hampshire, May 30.

The object of this invention is security from combustion by accidental friction of the matches against each other. Dry pine, or other suitable wood, is to be cut into blocks of proper length, and one end of each block is to be grooved both ways, by saws, so as to divide it into squares of a proper size for a match. Upon the other end a piece of cloth is to be glued, and by means of a knife, or other instrument, passed into the respective grooves, the block is to be split into matches, which will be still held together by the cloth, whilst the grooved ends, upon which the composition is put, will not be in contact with each other. The claim is to this mode of manufacturing splints.

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108. For improvements in the mode of constructing *Locks for the Doors of Buildings, &c.*, and in the night latches occasionally attached to the locks of outer doors; James McClory, City of New York, May 30.

This lock is of the kind in which there is a number of tumblers capable of being changed in their arrangement, the bit of the key also consisting of separate pieces, capable of a like permutation; this being a well known device, makes no part of the claim. The tumblers are arranged in a movable box, which can be readily taken out, without otherwise disturbing the lock, when it is desired to change their arrangement; the construction and arrangement of this, forms one of the claims. There is likewise a claim to "the manner of making the key in two parts for the purpose of placing the movable bits thereon, from the upper end of the lower section." This lower section, containing the bits, has a pin which fits into the barrelled part of the upper section, where it is fastened by a wedge. One of the knobs is attached to the spindle by a nut, in a way which appears to be new, and is claimed. These, however, and a movable racking in the night latch, can not be readily understood from description.

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109. For improvements in *Many Chambered Cylinder Fire Arms;* Otis W. Whittier, Enfield, Grafton county, New Hampshire, May 30.

This many chambered gun is to have the cylinder of chambers turned by a peculiar arrangement of the parts intended for that purpose. These contrivances have become so numerous, and most of them have proved, or are in a fair way of proving, so altogether valueless, that we deem it unnecessary to attempt a description of them, unless we meet with something which takes them out of the list of mere varieties, and gives to them a specific character.

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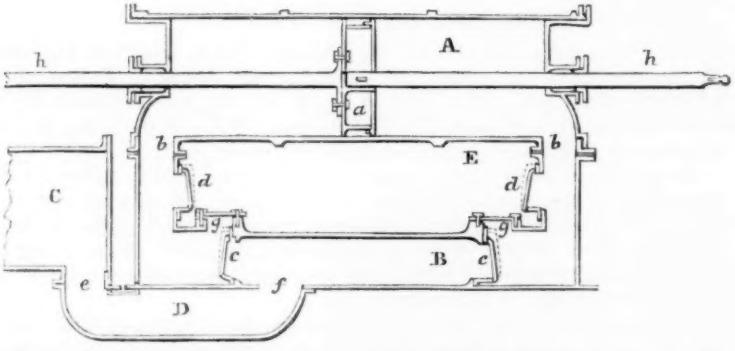
110. For improvements in *Apparatus for Drawing Liquids by Condensed Air;* Jasper Johnson, Genessee, Livingston county, New York, May 30.

This apparatus consists of a cock, and a tube which leads from said cock, down into a cellar or other place where the barrel, or vessel, containing the liquor, is deposited. Connected with this is a cylinder and piston, so arranged and combined with the cock and tube, that air may be forced down the latter by its means, until sufficiently condensed to cause the liquor to rise by the elastic force of the air. The peculiarity consists in an oblique aperture in the cock, which comes into play when the apparatus is employed for condensing, and the claim is to this part alone.

Specifications of American Patents.

Specification of a Patent for an improvement in the air pump of low pressure Steam Engines; granted to Thomas B. Silliman, *city of New York, May 15th,* 1837.

The nature of my invention consists in arranging a double acting horizontal air pump with its channels, passages, reservoir, and water pipes, in such a manner as to be applicable to steam boat engines, particularly those constructed upon the horizontal plan; the objects of which are to produce a more uniform effect, to lessen the concussion usually experienced in steam boats from their operation, and obtain such compactness or convenience as may arise from such arrangements.



The accompanying figure represents a longitudinal section of the apparatus; A, is the air pump; B the cylinder; C, a part of the condenser; D, channel plate, connecting the bed plate and condenser; E, reservoir; the water pipe is not seen in the section: *a* is the piston of the air pump; *b*, *b*, nozzles or openings of the same; *c*, *c*, foot valves; *d*, *d*, delivering valves; *e*, opening or nozzle of condenser; *f*, opening between channel plate D, and bed plate B; *g*, *g*, bonnets of foot valves; *h*, *h*, piston rods.

The air pump is operated by means of an upright lever, or beam, and proper connecting rods attached to the crosshead of the engine.

When in operation the water and air contained in the condenser, passes through the channel plate D, from *e* to *f*, into the bed plate B, between the two foot valves *c*, *c*, from thence through either foot valve al-

ternately into cylinder A, through the nozzles *b*, *b;* thence the water, by occupying the lowest place in the cylinder, returns first and passes into the reservoir E, through the opening of the delivery valves *d*, *d*, followed by the air and vapour which, by occupying the upper part of the cylinder, presses upon the surface of the water with an elastic force, which in addition to the gravity of the water, produces an easy delivery of the water into the reservoir, and avoiding the blow which the piston usually produces upon the water in the common arrangement.

What I claim as my invention and desire to secure by Letters Patent is, *First*, the arrangement of the channel way contained in the channel plate for the purpose of admitting the water into the bed plate between the foot valves. *Secondly*, the arrangement of the reservoir so as to receive the water from the two delivery valves attached to the opposite ends of the pump, and conduct it to the water pipe, through which it passes from the boat. *Thirdly*, the arrangement of the delivery valves and nozzles below the cylinder of the air pump, in such manner that the elasticity of the air, and gravity of the water may both conduce to the easy operation of the pump. *Fourthly*, the arrangement of the air pump of steam boats, horizontally, and in manner to allow its working a double stroke, with its combinations substantially as above described.

T. B. Silliman.

Specification of a Patent for improvements in the construction of Canal Boats; granted to Abraham Morrison, *of Johnstown, in the county of Cambria, and State of Pennsylvania, May 15th,* 1837.

To all whom it may concern: Be it known, that I, Abraham Morrison, of Johnstown, in the county of Cambria, and State of Pennsylvania, have invented a new and improved mode of constructing boats for canals, bays, lakes, and navigable rivers; and I do hereby declare that the following is a full and exact description of the same.

In giving my description I shall assume certain admeasurements, and proportion of parts, and although I shall, in so doing, give such as I believe to be well calculated to answer the purpose intended, I do not intend to limit myself in these particulars, as much latitude may be allowed in these respects whilst the principle upon which my improvements is dependent is still retained.

The form of the bottom of my boat is the reverse of that usually adopted, as, instead of being convex in the cross section, I make it concave in the cross section, from stem to stern. In building a boat of sixty feet in length, I take plank twelve feet long, thirteen inches broad, and one and a half inch thick, and these I cut to a curve of nine inches in their whole length, so that in the middle they will be only four inches wide. Of these there may be twenty-one pieces, which are to constitute the cross plank upon which the bottom and floor of my boat are to be fastened; the average distance apart of these cross pieces, when placed on edge, will be three feet. In building my boat, I first place these on edge, with the hollow side upwards, having first the side standards rabitted into, and riveted fast to the ends of the cross plank, to which the side plank are to be spiked, and so as to range properly, and then spike on the bottom sheeting of inch and a quarter plank. In arranging the cross plank and side standards, they are placed on a line for three

fourths of the length of the boat, and thence, towards the bow, they are to have such an inclination as will elevate it about twelve inches. The side plank is put on upon the ends of the cross plank, and spiked, or nailed, or screwed, to the side standards, so as to be about two inches below their lower corners, and they will consequently, project about an inch below the bottom sheeting; they are also to rise two inches above the floor, which will require plank of eighteen inches in width.

The cross plank being thus secured together, whilst this part of the boat is bottom upwards, it is then turned over, and the superstructure completed, a floor of strong inch plank is to be laid upon the cross pieces, and the side standards are to be raised, which may extend to the height of six feet above the floor, in a vertical line. The sides, top, stem, stern, and bows, may be finished in any way which may be preferred.

To give additional strength to this boat, I take two iron rods, each thirty feet in length, and three-fourths of an inch in diameter, and extend them from side to side of the boat, so as to cross each other at or near the centre, securing their ends firmly to the side plank, just below the floor. I also bolt the two sides together by means of six bars of iron, of the same size, crossing the boat about two inches below the floor.

Having thus fully described the manner in which I construct my canal boats, I hereby declare that I rest my claim to invention solely upon the form which I give to the bottom of the boat, which is concave from stem to stern, and straight, with the exception of the elevation towards the bows, as hereinbefore fully set forth.

ABRAHAM MORRISON.

Specification of a Patent for an improved Rail for Railways: granted to JOHN RUGGLES, *Thomaston, Lincoln county, Maine, May 23d*, 1837.

FIG. 1.

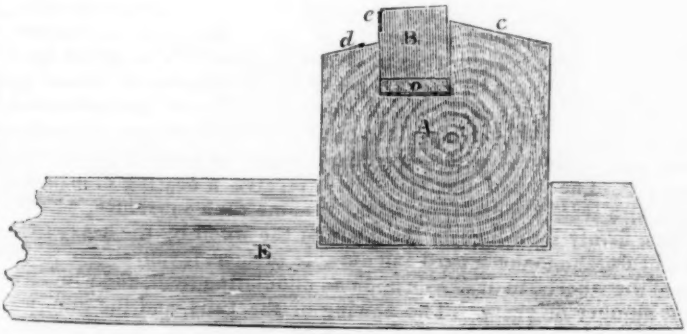
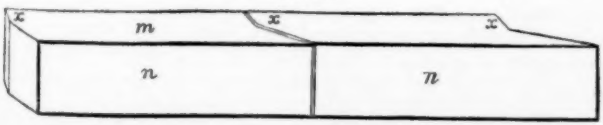


FIG. 2.



Be it known that I, John Ruggles, of Thomaston, county of Lincoln,

State of Maine, have invented a new and improved rail for railways, calculated greatly to diminish the expense of railways, increase the adhesion of the driving wheels of the locomotive engine, while it combines firmness and durability.

The following is a just description thereof; that is to say, string-pieces are laid on cross-ties, or sleepers, in the manner usual for supporting a flat-iron rail. The string-pieces may be eight inches in width by nine or ten inches in depth. Along the upper sides of the string-pieces, a tranverse section of which is seen at A, fig. 1, in the annexed drawing, is a groove three inches wide, being three inches and a half from the outside, and one inch and a half from the inside, for the insertion of a block rail B, fig. 1. The string-piece is bevilled at *c* and *d*, that water may not stand upon it; and the rail, which is three inches wide by four inches in depth, extends one inch above the string-piece on the outside, while the inside of the string-piece is reduced two inches below the top of the rail to make room for the flanches of the wheels. The block-rail is made of hard wood plank, by sawing the plank transversely to the grain of the wood, into blocks four inches in length, measuring with the grain, which being inserted into the groove side by side form a continuous rail with the grain of the wood perpendicular. The ends of the blocks where they unite in the rail should present, one of them, a convex obtuse angle, and the other a concave to correspond with it from top to bottom, to unite them more firmly, as shown at *x*, *x*, *x*, fig. 2. The blocks should be dowelled with three fourths inch dowels, and pressed firmly together by wedging or otherwise. If the string-pieces be of soft wood there should be laid at the bottom of the groove a base, of hard wood board, an inch in thickness, to prevent the rail from settling into the string-piece more in one place than another; this is seen at *o*, fig. 1.

On the inner sides of the rail there should be a plate of iron let into the rail a quarter of an inch below the top edge, and made fast with screws; it being intended as a defence of the rail against the flanch of the wheel, it may not be required except on the outside rail at curvatures; or they may be thicker at curvatures, and thinner in other places. The plate should be about one inch wide, and one-sixth of an inch thick, varying according to circumstances; it is seen at *e*, fig. 1.

The groove should be payed with a heated mixture of tar and pitch, and the seams at the insertion of the rails filled, to exclude water and prevent decay. The string-pieces and the rail should be painted, after being well seasoned, with some coarse paint to protect them from the weather. The top of the rail should receive a coating of paint made thick with iron filings, iron sand, or some such substance, which will become firmly imbedded in the grain of the wood by the heavy tread of the wheels, and make a hard and durable surface, favourable to the adhesion of the wheels, so desirable upon an undulating road, and will last for a great number of years. The sawing of the rails, and the grooving of the string-pieces may be performed by machinery expeditiously; and the adoption of block-rails, fixed as above described, will lessen the expense of railways, so as to admit of their construction in many locations which will not justify the expense of iron rails. They will be found in most cases more economical than iron rails, as well in their first construction as in their use and maintainance for any given series of years.

What I claim as my invention, is the block-rail so formed as that the tread of the wheel shall be upon the end of the grain of the wood of

which it is made, instead of upon the side of the grain; and the dowelling and confining the rail, and the top coating given to it as above described. I claim also the defending of the rail by a plate of iron, and the inserting a hard wood base for the rail to rest upon when the stringpieces are soft wood. I do not confine myself in the construction to the precise dimensions given, but claim any variation therein which the kind of timber employed, or the nature of the transportation contemplated, may justify or admit of.

JOHN RUGGLES.

Specification of a Patent for a machine for drying oil-cloths, such as are used for table covers, and granted to DANIEL SAMPSON, *Winthrop, Kennebec county, Maine, May 30th,* 1837.

Instead of extending out the cloth in length for the purpose of drying it, after it has received the paint, I wind it round a shaft, spirally, in such a way that the painted side shall be fully exposed to the action of the air whilst it is at the same time prevented from coming into contact with the contiguous coil, or with any part of the machine.

I construct two shafts, or cylinders, of sufficient length to have the painted cloth wound upon them, and mount them in a suitable frame parallel to each other. To wind the cloth on these cylinders I prepare a band of slats, which slats are united together at the ends by webbing, or by a leather or other strap of any convenient width. The slats are placed at any suitable distance apart, say one inch, and they must be of such length as to allow the cloth to lie upon them widthwise, between the connecting straps. The straps must be raised above the slats to a sufficient distance to allow a space for the cloth, which will prevent its painted surface from coming into contact with the contiguous slats, when wound. For this purpose I put between the strap and each slat, a thickness of sole leather, a small block of wood, or other suitable material.

The band of slats may be fifty or sixty feet in length, or longer if desired, and their ends are fastened respectively upon the two cylinders above named. When the painted cloth is to be operated on, the whole band of slats is first wound on one of the shafts; the end of the cloth is then attached to one of the slats, or to the shaft upon which it is to be wound; this shaft is then turned by a winch, or otherwise, as the paint is spread upon the cloth, and it is thus received and retained upon the slats and suffered to remain there until the drying is completed.

What I claim as my invention is the construction of a machine such as I have herein described, in which oil cloth is wound upon a shaft or cylinder, by the aid of a continuous band of slats, for the purpose of being dried, substantially in the manner set forth.

DANIEL SAMPSON.

Specification of a Patent for an improved mode of manufacturing Saddle Trees, of all descriptions; granted to WILLIAM KELLY, *White Deer Township, Union county, Pennsylvania, May* 30*th,* 1837.

To all whom it may concern, be it known, that I, William Kelly, of White Deer township, Union county, Pennsylvania, have invented an

improved mode of manufacturing saddle trees, of all descriptions; and I do hereby declare that the following is a full and exact description thereof.

My improved mode of manufacturing saddle-trees consists in the substitution of raw-hide, for the wood usually employed for that purpose, to effect which, I proceed in the following manner. After the hair has been removed from the hide, in the usual way, and the hide is properly broken, I draw, or strain it, whilst wet, either over a wooden saddle-tree, or over a mould properly shaped and prepared for that purpose, where it is to remain until it is perfectly dry and hard. Having in this way brought two, or more such pieces of hide into the proper form, I unite them together at their edges, by means of rivets, or otherwise; preferring, however, the employment of rivets to any other mode. The pieces of hide are, of course, cut to the proper size and shape for the intended purpose. I sometimes form the tree, or foundation of the saddle, of a single piece of raw-hide, in which case I turn the edges of the hide over, all round the outer and inner edges of the tree, and rivet through the double thickness. To this foundation, or tree, the irons usually employed may be fastened, as to trees of wood. Strips of spring steel, also, may be riveted on, whenever it may be deemed requisite, so as to increase the stability and elasticity of the whole: I usually affix such a spring all around the under side. After my tree, thus made, has received its proper form, and is ready for covering, I give to it a thick coating of any good water proof varnish, such as shellac, copal, or gum-elastic. In finishing the saddle any of the known modes of procedure may be adopted, according to the fancy or judgment of the workman.

All that I claim as my invention, is the forming of the trees, or foundations, for saddles, of all descriptions, from raw-hide, instead of using wood, or other material, for that purpose, as herein fully set forth.

WILLIAM KELLY.

English Patents.

Improvement in Locomotive Engines.

Specification of a Patent for an improvement in Locomotive Engines, granted to THOMAS ELLIOT HARRISON, *of the county of Durham. Enrolled June 21st,* 1837.

According to the common modes of construction, in the event of the boiler, the machinery, or wheels getting out of order, and requiring repairs, the engines, boilers, and indeed the whole combined machine is obliged to be laid up and become useless, till such part is repaired; and further, in order to get at the parts so requiring repair, many joints and parts of the locomotive-engines have, in most instances, to be taken apart, and in some cases the engine is obliged to be completely stripped; which causes very considerable cost, and puts out of use many parts of the combination not wanting repair. Now according to my invention, in case of any derangement taking place in the engines and parts connected therewith, the boiler and its carriage may at once be connected with another engine-carriage; and such is the case in respect to the boiler, should it or the parts directly connected therewith get out of order, and require repair, the engine-carriage may have such boiler and its carriage disconnected, and be applied to another boiler-carriage; hence much saving will be obtained in the working of locomo-

tive-engines on railways, and fewer spare engines and boilers be required. According to my invention, the boiler of a locomotive-engine is mounted on four or more wheels, suitable for travelling on railways, and the engine or engines are mounted or carried on a separate and suitable carriage; and the various four, or more, wheeled carriages for the boilers and the carriages of the engines being capable of connection when they are to work together, and there being some spare boiler-carriages and spare engine-carriages on a line of railway, in case of a boiler or its carriage getting out of order, or in case of an engine-carriage getting out of order, it will not be necessary, as heretofore, to lay up the boiler and engines; but the one or the other will, in most instances, be capable of being used, on being connected with a fresh boiler-carriage, or engine carriage, as the case may be.

In a locomotive-engine combined and arranged according to my improvements, the boiler is mounted on a carriage with six wheels, which is a very desirable number, when the length of the boiler is such as to require support to that extent, though under other circumstances four wheels may be employed. The construction of the boiler is of that kind which is very commonly employed on the various railways now working, and is an arrangement of boiler well understood, and consequently in itself forms no part of my invention; nor do I confine myself to the use of the precise form or construction of steam boilers, as it will be evident that variations may be made. The supply-pump to the boiler may be worked by an eccentric on the axis of one of the pairs of wheels, or by any other convenient means. The two steam engines or cylinders are affixed horizontally to their carriage, which is carried, by four wheels; but I do not confine myself to the use of that number.

For conducting the steam from the boiler to the engines, and from thence to the chimney, two ball and socket-joints are used, the one attached to the boiler, the other to the engine-machinery. To make these ball and socket-joints steam-tight, they are packed after the usual mode of packing, being pressed against the ball by segments, which are firmly pressed upon the packing by screws acting upon them from the outside. It will be further necessary to have between the ball and the sockets joints, described above, a double-sliding stuffing-box, to allow for elongation. The above description refers to a means of conducting the steam from the boiler to the cylinders, and a similar arrangement will be necessary to conduct the exhausting steam from the cylinders to the chimney. The tank for containing the water to supply the boiler may be fixed upon the engine-frame, or above the framing, and a connexion formed between it and the feed pumps by a hose, as is now done between the tender and pumps of the ordinary-engines. The fuel for the supply of the engine may be carried upon the boiler-frame.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that what I claim as my invention is the separating a locomotive-engine for railways into two carriages, one for the boiler, and the other for the engines, each carriage having four or more wheels, whereby in case of derangement of the boiler-carriage, or engine-carriage, the other may be connected with a spare or other engine-carriage or boiler-carriage, as the case may be. Great facility is thus offered for the making of repairs, or for replacing new boilers to the boiler carriages; and by this means much

saving of expense will result in the working of locomotive-engines on railways, as above described.

Repertory Pat. Inv.

Abstract of the Specification of Mr. Samuel Hall's Patent Paddle Wheel.

Fig. 1.

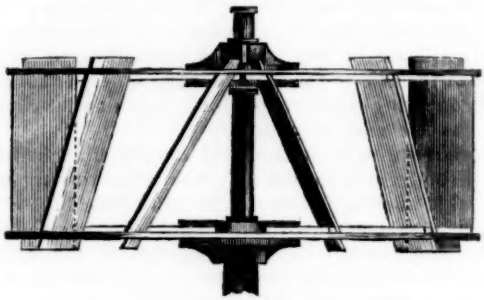
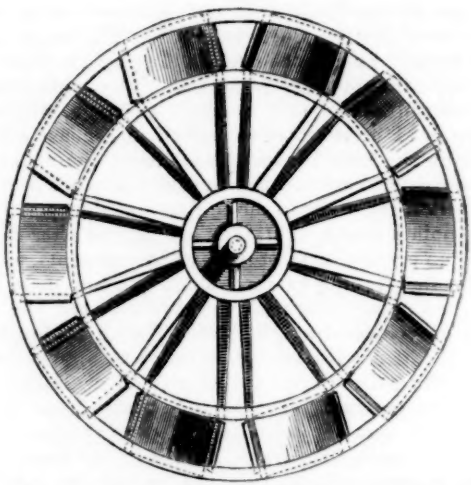


Fig. 2.



Mr. Samuel Hall, whose important improvements in steam engines have given celebrity to his name, took out a patent on the 24th of June, 1836, for "improvements in propelling vessels; also improvements in steam engines, and in the method or methods of working some parts thereof." The improvements in propelling vessels consist in the paddle wheel, of which the following is the exposition given in Mr. Hall's specification.

The object of my invention, as regards the propelling of vessels, is to reduce the tremulous motion of steam vessels and decrease the back water caused by common paddle wheels, without impairing the propelling power.

The manner in which this part of my invention is to be performed is shown at figures 1 and 2 of the annexed drawing, and consists of a mode of affixing the paddle boards to the paddle wheels, whereby during one half of the revolution of each paddle wheel the water shall be put in motion in one direction, and by the other half of the revolution the water shall be struck and put in motion in another direction, so that the paddle boards shall be constantly striking in an oblique direction against currents of water produced in different directions by the paddle boards themselves; this I effect by placing about half of the number of the paddle boards on the wheels in a diagonal position, so as not to enter the water in a line parallel with its surface, but diagonally in one direction, and by placing the other half of the number of the paddle boards so that they shall enter the water in the reverse diagonal direction, as shown by the annexed drawings. Figure 1 is a side elevation, and figure 2 an end elevation of a paddle wheel having my improvement applied; from these figures it will be seen that the paddle boards, instead of standing at right angles to the rims of the wheels and parallel to the axis of the wheel, as in wheels of the ordinary construction, are placed obliquely to the rims and to the axis of the wheel. The angle which the paddle boards should form with the axis may vary from 30° to 60°, but I prefer the mean of these two angles, viz., an angle of 45°. I have already stated, and it will be seen by the figures 1 and 2, that the paddle boards do not all incline the same way, but that half of the number incline in one direction, and the other half in the opposite direction. In large paddle wheels the oblique positions of the paddle boards may vary four times in the revolution of the paddle wheels instead of twice.

As relates to my improvements in propelling vessels, I do not lay claim to the use of paddle boards entering the water in a diagonal or feathering direction, that not being new, but I claim as my invention the making of about one half of them to enter the water in one diagonal direction, and the other half to enter it in the reverse diagonal direction, or in large paddle wheels in making the boards to change their direction of entering into the water four times during the revolution of the paddle wheels instead of twice; thus about a fourth part of the paddle boards may enter the water in one diagonal direction, the next fourth part or thereabouts may enter it in the other diagonal direction, and so on, changing their direction four times as above stated, during one revolution of the paddle wheels instead of twice. Lond. Mec. Mag.

Specification of the Patent granted to CHARLES BRANDT, *of Upper Belgrave Place, in the County of Middlesex, Machinist, for an Improved Method of Evaporating and Cooling Fluids.*—Sealed July 27, 1836.

The nature of my said invention consists in exposing the fluid to be evaporated or cooled, on a series of extended surfaces by means of endless webs or bands, or extended surfaces connected therewith, either, or both constantly moving through the fluid and through the natural or an artificial atmosphere, as the case may be. I hereby describe the manner in which my said invention is to be performed by the following statement:—

Fig. 1

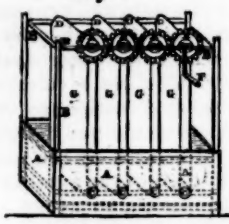


Fig. 1, is intended to represent a vat or tank of brewers' wort in progress of cooling by means of one modification of my said invention. A, A, A, A, is a vat-tank or reservoir of hot wort. B, B, B, is a frame to support the cooling apparatus. C, C, C, C, are four wooden rollers, which I call the lower rollers; and D, D, D, D, are four similar wooden rollers, which I call the upper rollers. E, E, E, E, are spur-wheels working into each other; and F, is a crank-handle fitted on to one, by turning which, motion is given to the whole. G, G, G, G, are four endless webs made of linen, hair-cloth, or other suitable substance. Now supposing the wort to be warm, but not sufficiently so to give off any perceptible vapour, if the handle F, is turned smartly round for a few revolutions, a dense steam or vapour will arise, and the temperature of the wort in the vat will be rapidly reduced. If the object be to evaporate rather than to cool, as for instance, in the process of evaporating brine in the manufacture of salt, then I make my rollers of any suitable metal or other material (dependent on the nature of the fluid to be evaporated,) and hollow, and introduce hot steam through both the upper and lower rollers, in order to heat the fluid in one case, and to drive it off in vapour from the web in the other, and in such cases I add to the endless web or band, leaves, or what I call surface-boards, or drip-leaves, as shewn in fig. 2, which represents one upper and one lower roller only of the apparatus, which will, when complete, be composed as before of a series of several. G, G, is the endless web as before. And the parts, similar to that marked H, are thin leaves of wood or metal, or other suitable material, sewed, laced, or otherwise hinged on to the web, and furnished with check-strings, as at J, J, J, by which a proper angle is preserved, as here shewn. As these leaves, which I call drip-leaves, are carried round by the web, a very extensive surface of the fluid is exposed for evaporation, which the constant dripping from the drip-leaves greatly promotes, and if the operation be performed in an artificially heated atmosphere, the result will be very rapid evaporation.

Report. Pat. Inv.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Smelting of Iron with Anthracite Coal. By G. Crane.

On Monday, the first day of the meeting, the following communication "On the Smelting of Iron with Anthracite Coal" was made by Mr. George Crane, of the Yniscedwin Iron Works, to the Chemical Section of the British Association.

The great extent of the deposit of that description of fuel called anthracite, or stone coal, in the Mineral Basin of South Wales, accompanied, as it is, with iron mine in great abundance, and of good quality, has long made it an object of great interest to parties connected with that district, to discover some method of applying that description of coal to smelting purposes. One of the earliest patents enrolled in this country for this object, was that of

Mr. Martin, in 1804. From the mode detailed in his specification, there does not appear to have been any peculiarity in his process; he evidently expected to have succeeded in using this fuel by the only mode of blowing a furnace then known, that by cold blast. Another patent was taken out about twenty years afterwards, for a mode of forming a conglomerate coke, composed partly of the small of the anthracite veins, locally called culm, with a sufficient portion of the small of the bituminous, or binding veins, to cement the whole, when coked in an oven together; had this latter plan been attended with success, its application would of course have been limited to those localities where the two descriptions of coal were to be found near each other.

The Yniscedwin Iron Works, which are in my possession, are placed upon the anthracite formation. Until I discovered the method of applying this particular description of fuel to the smelting of iron ore, I was obliged to avail myself of the coal of the bituminous veins, obtained from the adjoining parish of Rillybebill, for the supply of the blast furnaces at Yniscedwin. During the fourteen years in which I have been engaged in the iron trade of South Wales, I have had my attention anxiously directed to the application of anthracite coal to smelting purposes, and at different periods, at a large outlay, tried a variety of plans, but without success, until the idea occurred to me that a hot, or heated blast, upon the principle of Mr. Neilson's patent, might, by its greater power, enable me to complete the combustion of this peculiar coal. I have now the pleasure of reporting to this meeting, that I have completely succeeded in the application of anthracite to the smelting of ironstone and ore.

That I have used no other fuel in a cupola blast furnace since the 7th of February last, and that the success of the experiment in the combination of hot, or heated air, with the coal in question, as fully detailed in the specification of my patent of improvement, enrolled in March last, has been in every respect of so satisfactory a description, whether with regard to the quantity of the iron produced, the quality of such iron, and the economy of the process, that I am now, and have been for the last three months, actively engaged in making the necessary preparations for the introduction of anthracite coal, instead of the coke of the bituminous veins, upon the whole of the blast furnaces which I at present have (three in number) at the Yniscedwin Iron Works: that I have renewed all my mineral takings in the anthracite part of the basin for ninety-nine years, and that I have arrangements in contemplation for a large extension of the works, in consequence of the perfect success which has resulted from the experiment.

One of the three furnaces at present on my establishment, is a small cupola furnace, which we call No. 2, built from the top of the hearth with firebricks only; this cupola is of the following dimensions:—Forty-one feet in its whole height; ten feet and a half across the boshes, and the walls of the thickness of two nine-inch bricks; the hearth three feet six inches square, and five feet deep. The two other furnaces, which we call No. 1 and No. 3, are thick stone-walled furnaces. Some years since I found that this cupola furnace, No. 2 had, on the average of a long period (I concluded from the smallness of its dimensions and the thickness of its walls,) taken so large an excess of minerals to the ton of iron produced, when compared with the quantity taken on the average of the same period by the stone-walled furnace, No. 1, standing within fifty feet of it, that I determined to erect a second furnace, similar to the latter one, in lieu of it.

The meeting will shortly understand why I am giving these details, which

may at the moment appear not to be very interesting particulars. This cupola furnace, No. 2, not being at work when I arrived at the determination to try the experiment of the combination of the hot blast and anthracite coal upon the large scale, it was more convenient to put this furnace into blast for the purpose, rather than to interfere with the usual progress of my business by experimentalizing in either of the two other furnaces. The cupola furnace, No. 2, from the causes which I have before explained, had on the average of a long period taken cokes, the produce of five tons and three cwt. of coal to the ton of pig iron, when the stone walled furnaces had not required cokes to the ton of metal produced, quite equal to four tons of coal. The consumption of ironstone and limestone had been greater in the former than in the latter description of furnace, but not to so great an extent.

I will make one other explanatory remark on this part of the subject. The two descriptions of furnaces have worked in so different a manner with the minerals of my neighbourhood, that whilst the barrow of cokes, weighing about three and a half cwt., would take, when consumed in either of the stone-walled furnaces, a charge or burden of five to five and a half cwt. of calcined iron mine, of the descriptions obtained in my neighbourhood, according to the kind of iron which I was desirous of producing, the same barrow of cokes in the No. 2 cupola, or thin-walled furnace would only carry from three to three and a half cwt. of calcined mine of the same kind. Under these disadvantageous circumstances, I have actually produced from the No. 2 cupola furnace the ton of iron in the smelting process, on the average of three months, with less than twenty-seven cwt. of anthracite coal. The heating of the blast, and the calcination of the mine require, of course, upon my plan, the same quantity of fuel, which is necessary for the like processes in other establishments.

With regard to the quantity of iron produced, the result which I have to report is equally satisfactory. I must not, however, omit to mention that for the greater convenience of filling this cupola furnace, No. 2, from an adjacent gallery, previous to the commencement of my anthracite experiments, I raised it in height from thirty-six feet six inches to forty-one feet; this might have had *some* effect upon reducing the excess of the consumption of fuel when compared with that which had taken place in the No. 1, and might have increased its power of smelting with my blast of one quarter pound upon the square inch pressure, only from its former average of twenty-two tons to twenty-four. Since I have adopted the use of anthracite coal combined with hot air, my make in the No. 2 cupola furnace, with the same pressure of blast only, has ranged from thirty to thirty-four and thirty-six tons, and one week we actually tapped within three cwt. of thirty-nine tons of grey iron from this furnace; its present weekly average may be expected to range from thirty-five to thirty-six tons.

With respect to the quality of the iron produced by the combination of hot blast and anthracite coal, the result which I have to communicate will be very satisfactory; it is well known in my neighbourhood that my cold blast iron for all purposes, where great strength was required, was never deemed inferior to any smelted in South Wales; that which I have hitherto produced with hot blast and anthracite coal is, however, decidedly stronger than any other before smelted at the Yniscedwin Iron Works.

Relying upon the representations of chemists, that anthracite coal is almost entirely composed of pure carbon, I have always indulged the hope, that in the event of my ever succeeding in discovering a method of apply-

ing this fuel to smelting purposes, that I should be able to produce a quality of iron not very dissimilar to that formerly obtained by smelting with charcoal; how far this expectation will be realized further experience must prove; but, as far as my experience of the quality of this particular description of iron up to the present time has gone, I am sanguine with respect to the result. I shall be happy at any time to offer every facility in my power to any parties who may be deputed by this Association, or by any other scientific body, to thoroughly investigate this important subject.

If I have not trespassed already too long upon the time of the Section, its members may not be uninterested in being informed in what manner the idea first occurred to me of applying an heated blast to anthracite coal. One evening after I had placed a piece of it upon my parlour fire (which had before been made up with bituminous coal,) and had allowed it to arrive at a red heat, upon my applying as fierce a blast to this piece of coal as I could raise from a pair of bellows, I noticed the appearance of a black mark or spot upon that part of it where the air impinged upon it; on my continuing the like rapid current, in the same direction, I shortly blew the fire out of it. I at once perceived that the effect of the strength of the current of air, when cold, which we of necessity are obliged to blow into our furnaces to secure the passage of the blast through the high and dense column of materials contained in an erection like a blast furnace, instead of encouraging ignition, was actually unfavourable to it. On giving the thing but a moment's reflection, the question promptly occurred to me, What would be the effect of turning a blast into a furnace upon this coal, which would itself burn—which would itself melt lead? I at once determined that it was a thought which was really worthy mature reflection. The further consideration which I gave to the matter, and the further experiments which I shortly afterwards instituted, (which were continued at a great expense for some months,) have at length been crowned with the full success which I have now had the pleasure of reporting to this meeting.

The anthracite formation probably occupies about one third of the Mineral Basin of South Wales; it commences near the upper part of the vale of Neath, in the county of Glamorgan, and proceeds in a westwardly direction through the remainder of that county, thence through that of Carmarthen, and crops out, (as I am informed,) in the sea, in St. Budes Bay, after passing through a considerable portion of the county of Pembroke. It is likewise to be found in France, Austria, Bohemia, and Sardinia, in the Old World; and very large deposites of it have been already discovered on the continent of America, particularly in the state of Pennsylvania.

Proceedings of the British Association.—Mining Journal.

Improbability of explosions in Steam Boilers by the generation of Hydrogen Gas.

Although the question of the production of hydrogen in a steam boiler when suddenly replenished with water while the metal is in a state of incandescence, and consequent explosion from a mixture of the inflamable gas with atmospheric air was treated with sufficient clearness by the committee of the Franklin Institute, as may be seen by a reference to the report, (Jour. Frank. Inst. Vol. XVII, p. 217.) Yet as danger from such a source has been much insisted upon and may still be apprehended by some who have not taken the trouble to read that report, it may not be unadvisable to introduce the opinion of an able engineer, given in testimony before the proper authorities at Hull, in consequence

of the disastrous explosion of the Union Steam Packet, at that place. Not knowing at what period precisely, this evidence was taken, we cannot judge of the possibility of the witness having seen the report of the Franklin Institute. His opinions coincide with the conclusions of the committee, and in reference to the results thus experimentally obtained, we may adopt the words of a writer in the London Mechanics Magazine, June 17th, 1837;—"in fact, the report altogether ought to be studied by every one having the responsibility of the direction of a steam engine, and human life in his care."

A verdict of manslaughter was rendered by the jury, against the engineer, in the case above referred to. G.

*Mr. T. J. Pearsall** stated—"I have considered the subject of the explosion of the boiler of the Union. In my opinion it could not have taken place had the boiler been sufficiently supplied with water, unless the steam generated was prevented escaping by some very great force, which should hold the safety-valve fastened down or obstructed. I consider the immediate cause of the bursting of the boiler to have been the expansive power of steam, because steam is capable of producing any such effects. I am most decidedly of opinion that it did not arise from gas. My reasons for that opinion are that although water is decomposed readily by red-hot iron, yet it requires that the surface of the iron should be in a metallic state; a new boiler is nearly in that condition, but not quite so; there is just the chance that if a new boiler were employed, and very pure water admitted in small quantity, so as to allow portions of the boiler to become red-hot, then water might become decomposed; but such circumstances would at the same time be sufficient to generate an incalculable amount of steam. Such explosion, therefore, would arise from mixed causes—such as the presence of the gas, and the enormous amount of steam, and its great pressure. I cannot suppose a case where such decomposition of water and evolution of gas would take place, where such water is employed as that of the Humber, or as that furnished by the Ocean. Such gas would not be inflammable of itself,—there must be the presence of atmospheric air or oxygen, and of flame, or a substance heated to a very high degree.

"I can scarcely imagine such an explosion in a boiler, because there must be also a mixture of oxygen with hydrogen in proper proportion. I cannot conceive in what manner atmospheric air could gain admission to the boiler the pressure of the gas from within being greater than that of the air from without, and the aperture which would admit the atmospheric air would allow the escape of the hydrogen. Hydrogen gas would operate upon the safety-valve in the same manner as steam. *I know not one single instance of one particle of evidence of the presence of hydrogen in a boiler.*

"When a boiler has been at work some time, and becomes incrusted with saline and other earthy matter, it is quite contrary to all known chemical principles, to suppose that water can be decomposed by such earthy substances; it is quite hypothetical to suppose that it can be so decomposed. I do not know that under any circumstances water could be resolved into its two elements—hydrogen and oxygen—by heat alone. In all cases the quantity of hydrogen generated must be very limited compared with the

*This gentleman was a pupil of Prof. Faraday,—was several years the assistant, in the Royal Institution, of that eminent investigator, and has recently retired from the Professorship of Chemistry in the Medical School at Hull, to direct the manufactures on a large scale, which eminently depend upon that science.

amount of steam formed by the high temperature. I would say that if hydrogen were in the boiler, and oxygen were to gain access, the hydrogen would escape by the same means as the oxygen entered; the pressure of all gases is the same when generated, and it is impossible to conceive that hydrogen should have less pressure than that of atmospheric air at the same temperature. It would require a very large portion of the oxygen of the atmosphere to be in contact with the hydrogen in the boiler to cause an explosion. In 100 parts of atmospheric air there are only about 20 of oxygen, and it is that alone which is required to explode the hydrogen, the nitrogen of the atmosphere having only the effect of diluting it. A possible introduction of air into a steam-boiler may be that of the air contained in the water itself, which may be evolved when the water is boiled, but this quantity of atmospheric air is very small, about four per cent. of the bulk of the fluid water, and not so much air as that can be obtained from sea water. In round numbers one cubic inch of water will afford 1700 cubic inches of steam, which, decomposed at that temperature, expands into thrice its volume of gases, two-thirds being hydrogen gas, requiring about 17,000 cubic inches of atmospheric air for full and rapid combustion, while the original cubic inch of water only gave off one-twenty fifth of its bulk of air.

"If safety-valves be of the proper size, and steam be raised gradually, the valve will operate; but if you raise an enormous amount of steam at once, or under extraordinary circumstances, and wish it to be at once discharged, such circumstances, as when you have too little water, and portions of the boiler be red-hot, and by a motion of the vessel any sudden evolution of steam is caused, then the valve will be rendered comparatively useless or dangerous. I consider steam capable of producing an explosion such as this. I know of no greater explosive power than steam, except gunpowder. Perkin's patent gun, in the Adelaide Gallery, daily throws off a number of balls per minute by steam; and if gas be produced by means similar to those alluded to, it must be produced in the instance of Perkins's gun; had the explosion been caused by gas, it must have been accompanied by a very vivid flash." Mag. Pop. Sci.

Advantages of Anthracite coal in the Hot Blast Furnace.

At a meeting of the Royal Cornwall Polytechnic Society on Wednesday, Oct. 11, Mr. R. W. Fox stated that he had received that morning, a paper from a relative of his in Wales, Joseph T. Price, Esq., from which the following are extracts:

"Our experiment at Neath Abbey has shown that, by combining a portion of bituminous coal, coked in ovens with a portion of anthracite, 20 cwt. of cast iron may be made by 33 cwt., $\frac{3}{4}$ths of the former, $\frac{1}{4}$th of the latter.—The iron made by using the hot blast is generally more tender, more lead-like, and more easily broken, than when coke or bituminous coal only is employed. By the use of the anthracite in the proportion stated, and also without any mixture of bituminous coal, it is materially stronger, and I should say better, and really more valuable as a marketable article, and for the uses to which it is applicable.—Our experiments are only commenced, I am, therefore, not prepared to state more than very general results.—When complete success had attended the use of the quarter part anthracite with three-quarters part of bituminous coke, we put on the furnace half of each. The result was that the change checked the make of iron one-half nearly—40 charges of iron-stone, coal, and coke, in twelve

hours were reduced to 20 by it, and consequently the yield of iron proportionately. However, we quickly returned to the quarter anthracite, and three-quarters coke." The letter went on to state that the advantages already obtained were a diminished consumption of fuel, and an improved quality of iron. The precise degree of improvement could only be generally stated at present.

Mr. Price proceeds to say—"I transmit a specimen of anthracite iron, made at Neath Abbay; I call it anthracite iron, because it was enriched and its nature strengthened, by a mixture of about a quarter part of anthracite, or stone coal with three parts of coke, made in ovens from bituminous coal. — Before I close, permit me to offer through your society, a premium of ten guineas, for the best experiments, on the strength and tenacity of Anthracite Cast Iron, 1st and 2nd fusion, distinguishing the proportion of each kind of coal used, as compared with the strength and tenacity of Welsh, Scotch, and English cast iron of parallel qualities, 1st and 2d fusion, made with ordinary coal or coke, to be accompanied by a well-attested statement of the proportion of coal, anthracite, or stone-coal, and of the kinds of mine-ore and flux, used in the manufacture of each."

Mr. Fox then stated an interesting fact, mentioned to him by a gentleman from the Brazils, who had been engaged extensively in mining; that the veins there, as here, run north and south, exemplifying the magnetic power and the magnetic meridian. He said it might be remembered that he last year exhibited some specimens of copper ore, which had been altered by long-continued electrical action. He now produced some specimens of clay, in which veins and insulated portions of copper had been formed by the same agency. They were formed in masses of clay separating the copper ore from the zinc in the manner which he had heretofore described, and in which the electric action had long continued. He had also to lay before the meeting some clay which by means of the same agency had assumed the laminated appearance of clay slate. (These specimens were then produced to the meeting.) Mr. Fox proceeded to say that it was not a little gratifying to him to present to the society such strong evidence in favour of those views; and which appeared to him to be no longer questionable, at least as regarded the *laminæ* of clay-slate, and other rocks of a corresponding structure; and he thought it not improbable, that similar evidence might ere long be obtained, that the symmetical joints of rocks are due to similar agency.—Thus it appeared, he said, that the structure of rocks had a direct tendency to confirm the theory which he had endeavoured to put forth relative to the formation of mineral veins: and the facts which from time to time had come under his notice, had tended more and more to satisfy him of the influencial agency of electricity in their production. Indeed, he believed, that the structural and relative characters and qualities of coal-beds were also connected with chemical action.—Several other gentlemen then addressed the meeting, and some premiums announced for the next year.—Subscriptions were entered into to enable the society to build a gallery.

But one feeling prevailed on the occasion of this meeting, and that was one of high gratification at witnessing the important benefits which this society has already conferred on this county in particular, and on the country in general. The committee and every person connected with its management deserve the warmest approbation.

Lond. Mec. Mag.

Mica as a Substitute for Glass.

This beautiful substance, which may be termed elastic glass, is capable of being appropriated to many useful purposes, to which it has not been hitherto applied, except by one or two individuals. One reason for the apparent neglect of this most beautiful and unique mineral may have been its scarcity in this country. We have frequently purchased it at the rate of twenty and twenty-five shillings a pound, whereas it may be imported at one third the sum. We believe that a considerable portion of the mica imported into England is required for a new kind of stove, which we, however, have never seen in operation. It is used also in the construction of cards of magnetic compasses, as it has the peculiar property of always preserving its plane, so that when pasted to the under surface of the card, it prevents it from warping.

Several years ago we applied mica to a new and very useful purpose, for which it is particularly adapted, and we should have publicly recommended its adoption, had not gas lights almost entirely superseded the Argand Lamp. As glasses, however, are often used with gas burners, we take the opportunity of stating, that in order to convert the mica to this purpose, it should be split as thin as possible, and then bent round into a cylinder, the edges lapping over each other a little, and secured by a thin slip of brass rivetted to the mica. It is infinitely preferable to glass for this purpose, as it is neither liable to break nor to be burnt.

There is another most important use for which mica is peculiarly adapted, although we have never heard of its having been so applied. We advert to its substitution for glass in hot houses, as the substance, from its elasticity, would endure the most tremendous hail storms, which are often known to destroy hundreds and thousands of glass panes. Mica has long been used as a substitute for horn in lanterns, and the application is judicious, as independent of its superior transparency, it is not liable to be destroyed or even affected by contact with the flame, which would blister and destroy horn. We are not aware that mica has ever been used for the slides of the magic lantern, but it is preferable to glass, because independent of its elasticity, it admits of having the figure drawn and colored with more facility than glass.

We have also succeeded in silvering mica, so as to form very perfect and elastic mirrors, which may be carried in a pocket-book.

Having occasion for a cylindrical mirror, for that beautiful optical instrument for restoring distorted images to regular figure, we found mica particularly adapted for our purpose, from the facility with which, after being silvered, it could be bent into a cylindrical form. We believe no name has been assigned to this elegant instrument, which has, however, been fully described in "Hooper's Rational Recreations," and in Priestley's large "Treatise on Vision, Light, and Colours," amongst the plates of which it is numbered 53.

We have tried some experiments with the mica, as a surface upon which to work with the graver or the etching tool, and we have long thought that it might be advantageously used in the lithographic process. If our conjecture should be well founded, it would be extremely acceptable to travelling artists, as they might make their sketches on the spot upon the leaves of mica, and afterwards pass them through the press. We have now before us a small copy of a well known picture of Wilke, printed in lithography, from a surface of mica, and we shall leave it at

our office for the inspection of any scientific gentlemen who may wish to examine it.

A few days ago we met some very fine specimens of water colours upon mica, executed at Patna, in Hindostan; and as this use of the substance is probably new to the scientific gentlemen now in Liverpool, we have prevailed upon the gentleman who has the specimens, to leave some of them with Messrs. Wordley and Mayer, silversmiths, in Lord street, for the inspection of the curious. One of these specimens, representing Indian costumes, may also be seen in the window of our office. If the surface is suitable for oil painting, it would open quite a new field to our artists, especially our miniature painters, as the picture would at one process be painted and glazed. Mining Journal.

New Sand for Glass making.

The silver medal of the Society of Arts was awarded for the discovery of a sand in the colony of New South Wales, eminently fitted for the manufacture of the finer kinds of glass.—The following notes on the subject are interesting:—In the year 1831 it was observed, that in many places between Sydney and Botany Bay the surface of the ground was covered by a remarkably pure and white siliceous sand, derived from the decomposition of one of the beds of sand belonging to the coal formation. Mr. King, of Sydney, the discoverer, being of opinion that this sand would be found peculiarly applicable to the business of glass-makers, forwarded eleven bags of the same to his agents, Messrs. Buckle, Baxter, and Buckle of London. These arrived in June, 1832, and some was put into the hands of Messrs. Pellatt and Co., of the Falcon Glass-house, for trial. In August of the same year they reported the result of their experiments. From their report the following is an extract:—"We find the sand from Sydney to be decidedly superior to any we have previously employed. The most esteemed property of this sand, and that which makes it of the greatest importance to glass-makers, is derived from the absence of oxide of iron and every other combination that would affect the colour of the glass when made. It is also free from insoluble matter. Glass made from this sand is more brilliant and watery than any other. We consider it fortunate at this period that this sand has been discovered, as the sand with which most glass-makers were supplied is now of very bad quality, and has been given up by many." According to an analysis of a sample of this sand, made conjointly with Mr. Children, of the British Museum, and Mr. Garden, it appears to consist of 95.0 silica, 2.2 sulphate of lime, 0.4 oxide of iron, with a trace of alumine--making 97.6; leaving 2.4 for organic matter, water, and loss, the whole will be 100.0. On application to Mr. Pellatt the following further particulars were obtained:—He says that the recent arrival of a few hundred weight of this superior silex had enabled him to make a second experiment, which turned out fully as well as the first. He is of opinion that the Sydney sand exceeds all others heretofore in use, for whiteness, brilliancy, and fusibility; and he has little doubt, should the freight be moderate, that this comparatively pure material will be imported in large quantities for glass-makers' use in this country. He had mixed it with the usual proportions of carbonate of potash and nitrate of potash, with a rather less proportion of manganese than other sands require. Mr. Pellatt adds, that he hopes soon to be able to report on the Sydney sand as regards flint glass-

ware for optic plates. A few tons of the same kind of sand were lately imported into Liverpool, and were eagerly purchased, so that a considerable improvement in the qualities of the finer kinds of flint glass may soon be expected. Ibid.

On the action of Cold Air in maintaining heat. By Robert Addams, *Esq.*

I was at Sheffield in last December, and then a Mr. Linley, bellows-maker of that town, showed me the following curious experiments: first, a rod of iron, about an inch in diameter, was heated at one end in a forge fire, up to a full white heat, then quickly withdrawn from the fire and exposed to a strong blast of cold air from a forge bellows; the iron immediately became so hot as to fuse, and the liquefied matter was blown off and burnt in the air with the scintillating appearance of iron wire burning in oxygen gas; and so continued to melt until a pound or more of the metal had been thus wasted.

Another mode of producing the same action consisted in heating a rod of iron, as before; but instead of a blast of air, it was tied to a cord, and by it whirled round in a vertical plane; thus by passing swiftly through the cold air it melted, and was thrown off in beautiful scintillations, appearing as luminous tangents to the circle in which the bar was moved.

I have since applied a heated bar of iron to the periphery of a revolving wheel, and by an including tin hoop or guard, it is thus made an interesting class experiment.

The cause of this augmentation of temperature is, I conceive, referable to the oxidation of the metal, which takes place freely under the conditions of the experiments here recorded. Then, as is well known, the formation of the oxide is accompanied with a great development of heat; and the cases before us are striking examples of the heating influence by chemical action predominating over the cooling effect of the air conjoined with the radiating force.

The success of these experiments chiefly depends upon having the iron at first of a sufficiently high temperature, and upon the velocity of the air from the bellows, or otherwise the velocity of the iron through the air. For the iron at a white heat is greedy of oxygen, which the air solidifies. Then the oxide thus formed requires to be blown or whirled off, in order that fresh surfaces of the *metal* may be exposed to the air.

When the blast is employed, we see the oxide fusing, and deep channels scooped out in the bar by the rushing air on that side where the current is directed. Lond. and Edin. Philos. Mag.

Iron Steam Vessels.

The Rainbow, an iron steam vessel, built for the General Steam Navigation Company, has been launched since our last, from Mr. J. Laird's yard, at Birkenhead, near Liverpool. She is the largest iron steam vessel built or building in this country, her dimensions being, length over all, 213 feet; beam, within paddle-boxes, 25 feet; extreme width, 49. She is divided into six compartments, by five water-tight partitions, which entirely remove all danger of sinking in case of collision with other vessels; and if all the other advantages iron vessels possess are left out of view, the simple fact, that in them these partitions can be rendered most efficient and secure, will, we

have no doubt, cause their general adoption, both for sea-going and river vessels. The Rainbow is now being fitted by Messrs. Forrester and Co., with a pair of ninety horse power engines; and her cabins, which are of the most spacious and elegant description, are also in a forward state. The Rainbow is the tenth vessel built by Mr. Laird, with water-tight compartments, and we understand that he has now three other large ones building on the same principle. We are induced more particularly to notice the launch of this vessel, as an iron steam boat, called the Sirius, lately launched at the Isle of Dogs, is wrongly stated in the *Railway Magazine* to be the longest yet made of iron. She measures only 164 feet in keel, and 176 on deck, with a beam of 17 feet. She will have two high-pressure engines of thirty-five horse power each, with twenty-four inch cylinders of three and a half feet stroke, and three boilers with copper tubes worked expansively. She is divided into four compartments, by three iron water-tight bulkheads similar to those of the Rainbow; but it will be seen, on comparing the dimensions we have given, that she will not bear a comparison with her northern rival. It is confidently expected that the Rainbow, from her superior model and light draft of water, will be one of the fastest vessels afloat. The Sirius is intended for the Rhone, and it is no difficult matter to see that these iron steamers are gradually becoming general.

Nautical Magazine.

Progress of Physical Science.

British Association, September 12.—*Vegetable Physiology.*

Mr. Bowman read a paper from Mr. Gardner, "On the internal structure of the wood of Palms." The attention of Mr. Gardner, who is residing in Brazil, was directed to this subject by the remarks made by Professor Lindley, in his "Introduction to Botany." In order to test the truth of the theory of Mohl, he made several experiments on the palms in his district. He made a vertical section of a palm, four inches in circumference, and, by doing this, he could trace very plainly woody fibres proceeding from the base of the leaves to the centre of the stem, at an angle of 18 degrees; they then turned downwards and outwards to within a few lines of the external cortical part of the stem, running parallel with its axis. The distance between these two points was about two feet and a half. The fibres were traced quite distinctly up into the centre of the leaf. In answer to the questions proposed by Lindley in his work, the author stated:—1. That the wood of palms was always hard and compact outside, gradually getting softer towards the centre, the fibres of the upper leaves not descending to so great a depth as the lower. 2. The wood is much harder at the bottom than any other part of the stem, the inhabitants of tropical climates using only this part for economical purposes.

Professor Lindley observed, that this paper confirmed the views of the structure both of endogens and exogens, which had been increasingly embraced by botanists. In the first place, the views of Mohl on the structure of endogens were confirmed. There was, however, a slight difference between Mr. Gardner and Professor Mohl; the latter having stated that the woody fibres of endogens terminated *in* their cortical integument, whilst the former had traced them only within a few lines of this point. In the next place, the paper confirmed the theory of the for-

mation of wood from the emanation of fibres from the leaves. Whatever might be the difference between the arrangement of the fibres of exogens and endogens, there could be no doubt that their origin was the same. Mr. Gardner had referred, in his paper, to the glandular disks on the woody fibre that were, at one time, thought to characterize the order Coniferæ. He would, however, draw the attention of the section to a fact that had lately been discovered, and not hitherto published, that these glandular disks existed on all the woody fibres of plants that yielded resinous matter. Brown first discovered them in the wood of Tasmania, *(Winteraceæ,)* and Griffiths had since demonstrated them in Spherostema, *(Schizandreæ.)*

Mr. Nevin detailed some experiments on vegetable physiology. The experiments were performed on elms forty years of age, in February, 1836.

1. The stem of the tree was denuded, in a circle, of its cortical integument alone, leaving the alburnum beneath uninjured. On the May following the denuded part was filled up by the exudation of bark and wood from the upper surface of the wound, and the tree had not suffered in growth.

2. The bark and *cambium* were removed in the same manner. In August 1837 this tree sickened, and there was no formation of wood or bark in the wounded part. Two developments, however, took place one above the other, from below; the former having the appearance of roots, the latter were branches with leaves.

3. The bark and two layers of alburnum were cut away. The tree was at the time unhealthy; it however put forth its leaves on that and the ensuing spring, but shortly after died. No sap was observed above or below the wounded part. Roots were developed from the upper, and branches from the lower part of the section.

4. The bark and six layers of alburnum were taken off. The tree became much less vigorous, but did not die, and otherwise presented the same appearance as the last.

5. The bark and twelve layers of alburnum were stripped. The consequences were again similar to the last two; the alburnum above and below the cut being dry, but an accidental cut that penetrated into the heart wood exuded sap.

6. This was a repetition of the experiment of Palisot de Beauvais, by cutting away a circular ring of bark around a single branch. The branch continued to grow, and roots sprouted from the under surface of the isolated bark and branch.

7. In this the whole of the wood of the tree was cut away, except four pillars, composed of bark and sap wood. In this case, the sap first appeared from above, descending by the pith, and then from the heart wood, the alburnum being dry. In this case the sap must have passed up the alburnum, and horizontally through to the heart wood.

Mr Nevin inferred from these experiments—1. That the life of the tree does not depend on the liber or cambium. 2. A descent of sap takes place before the development of leaves. 3. That new matter arises from below: which had not previously been allowed. He thought there were two distinct principles in the tree,—one, the ascending or leaf principle: the other, the descending or root principle. Mr. Nevin had also performed some experiments on the conversion of roots into branches, and came to the conclusion, that buds or branches might be

developed from any part of the root above its extreme end, from which point it was impossible for buds to be developed.

Professor Lindley remarked that these experiments confirmed entirely the theory of the structure of wood adopted by Du Petit Thouars. He did not think that the existence of any new principle could be inferred from the experiments. In the seventh experiment the horizontal circulation of the sap was proved, and confirmed the accuracy of Hall's experiment of cutting a tree nearly through on alternate sides, when the sap still ascended. Lon. & Ed. Philos. Mag.

Artificial Production of Rubies.

A few months since M. Guadin presented to the Academy of Sciences of Paris a note, in which he announced his having been able to produce rubies in considerable quantities by a process of which he has given merely a sketch.

In order to obtain these substances analogous to rubies, M. Gaudin uses a platinum blowpipe of a single piece, formed of two hollow concentric cylinders, communicating by one of the extremities, one with a reservoir of hydrogen, the other with a reservoir of oxygen; the two other extremities are pierced with convergent openings, so as to effect in a great degree the mixture of the gases.

It is well known that alumina is fusible with the oxygen and hydrogen blowpipe; but no one before M. Gaudin had endeavored to melt this earth into globules several millimetres in size. Having submitted a piece of potash alum to the action of his blowpipe, he obtained a perfectly round and limpid globule. The platinum tube being perforated and melted at several places, he obtained after the cooling, instead of a limpid spheroid, an opake elongated globule, and covered internally with crystals, which may be referred to the cube or to the rhombohedron. These crystals scratch rock crystal, topaz, garnet, and spinelle; with regard to hardness, therefore, they agree with the ordinary ruby. They appear to be composed solely of alumina, the potash votalizing at the high temperature to which the alum is submitted.

Having obtained an apparatus stronger than the one first used, he made an experiment with some ammoniacal alum mixed with from 4 to 5 thousandths of chromate of potash; the whole being previously calcined, he gave it the form of a spherical cup, in order to obtain a maximum effect, by directing the flame to the concave part. In a few moments the inner surface of this cup was covered with globules of a beautiful ruby red colour, slightly translucid, and some of which exhibited the form and cleavage of the ruby.

M. Malaguti, who had occasion to analyse these globules, found them to be composed of 97 parts alumina, one of oxide of chrome, and two parts of silica and lime; which composition is analogous to that of the ruby. Comptes Rendus, August, 1837, p. 325. Ibid.

A New Organic Acid.

M. Peligot has read to the Academy of Sciences some observations on cane sugar, and on a new acid derived from the action of alkalies on sugar of starch.

It is well known that there exist two distinct varieties of sugar; one

of them is common sugar, extracted from the cane, beet root, and the maple; the other occurs in grapes and diabetic urine, and is formed when starch, lignin, or sugar of milk is treated with dilute sulphuric acid. It is also known that, influenced by various circumstances, common sugar may be converted into sugar identical with that of starch.

Among the differences which exist between the two kinds of sugar, one of the most prominent, (says M. Peligot,) is in my opinion that which is observed when these bodies are put in contact with alkaline bases.

Common sugar, when added to potash, lime, or barytes, combines with these bases, and acts towards them the part of a true acid*: by boiling a mixed solution of barytes and sugar, I obtained by direct action a crystallized compound of these two bodies; the analysis of saccharate of barytes, and other analogous salts, proves that the sugar does not undergo any particular modification: on decomposing the saccharates by weak acids, the sugar re-appears with its usual properties.

The case is entirely different with sugar of starch; the alkalies effect an essential alteration in it. On putting lime or barytes into a solution of this sugar, even cold, I observed that after a certain time these bases had lost their alkaline properties, and were saturated with a new and very powerful acid, which is formed by simple contact with the sugar, and which immediately unites with the alkalies, and forms perfectly neutral salts. This acid may be still more readily obtained by putting dry sugar of starch, fused at 212°, in contact with crystallized hydrate of barytes. Vivid re-action takes place almost immediately; the mixture swells, the temperature rises very much, and in a few seconds the sugar is transformed into acid. The barytic salt is then dissolved in water, and the acid is precipitated by means of a solution of subacetate of lead, to be gradually added, in order first to separate a brown colouring matter which arises during the re-action, at least when operating in contact with the air. The last precipitate obtained is colourless, and contains the acid in a state of subsalt; it may then be separated by the usual means.

Besides this acid, another non-volatile body is produced, which possesses the property of immediately reducing, when cold, the salts of silver and of mercury.

The very easy formation of an acid, by the contact of sugar of starch or grapes, with bases, (M. Peligot observes,) shows how proper it is to avoid the employment of too much lime in the purification of the beet root juice; for although lime does not alter the sugar, it acts, when in excess, upon the sugar analogous to that of grapes, into which common sugar is easily converted by the influence of heat, acid, or fermentation. There are therefore two difficulties to be avoided; these may be apprehended at the same time,—the intervention of acids which decompose the sugar intended to be extracted, and the effects of the alkalies which act upon the sugar of starch resulting from this decomposition.

L'Institut, Août, 1837.— Ibid.

*See London and Edinburgh Philosophical Magazine, Vol. XI, p. 152.

Progress of Civil Engineering.

On a peculiar form of Rail, and the construction of Railways in America and Germany, by HERMAN KOEHLER, *of Leipzig M. Inst. C. E.*

The pattern, which the author describes, is by American engineers called the inverted T rail, (⊥), and was introduced in order to avoid trouble and expense, which railways are liable to where the rails are placed in chairs and fastened with keys. The material used for this need not be of first quality, but in cases where it is expedient to support a general confidence in the quality of the iron, good and sound rails can be made of $\frac{2}{3}$ths of No. 2, Welsh iron, and $\frac{1}{3}$ths of No. 3, employing the better quality for the head and bottom, and No. 2 for the stem of the rail, rolled in such manner that the lamina of the iron lie horizontally throughout.

The experience of all railways seem to confirm the opinion that chairs and keys to keep the rails firm to their places, are a great and expensive inconvenience, and a dangerous construction, whether wood or iron be the material of the keys. The author then details the advantages of the rail, especially if laid on a continuous line of stone or wooden sleepers at a small distance apart.

Wooden railways are at this time used in Germany, and the author has laid 9 miles between Leipzig and Dresden. Wooden sleepers, 8 inches square, are placed upon trenches cut across the embankment at every yard, and filled up with a bed of broken stones, one foot deep. Notches $3\frac{1}{2}$ inches deep are cut into these cross ties to receive the wooden rails of 6 by 9 inches, which are shod with iron plates of one inch thickness and $2\frac{1}{2}$ inches width. At their joints they are put together on iron plates $\frac{1}{8}$th of an inch thick, to prevent their being pressed into the wood. The rails are wedged firmly to the sleepers by wooden wedges. The head of the spikes with which the iron rails are fastened to the wood are of a conical form and fit into corresponding holes, these having an eliptical form to prevent the spike from being drawn or bent on the contraction or expansion of the iron rail. The ends of every iron plate rail are fastened with screw bolts, passing through the whole height of the wooden rails, holding them firmly to their places, which is a very important precaution, as the engines are apt to catch the points of the plate rails with their wheel flanches and to run off.

Trans. Insti. Civ. Eng.—Lon. Jour. Arts & Sci.

On the Construction of Railways of Continuous Bearing, by JOHN REYNOLDS, *A. Inst. C.E.*

The author states the conditions essential for a good railway to be as follows: 1st. That it should be the closest practical approximation to a perfect plane of perfect stability. 2nd. That it should be adapted to prevent or to neutralize the vibrations from the impact of imperfect cylinders rolling on imperfect planes. 3d. That it should possess the greatest durability and the greatest facility of being repaired which are compatible with the above conditions. Mr. Reynolds proposes trough shaped cast iron bearers, having rectangular bearing surfaces, the angular point being downwards. Thus a section of the bearing part of the rail across its length is a right angle, with its vertex downwards. By this peculiar shape the sustaining area is increased, a greater resis-

tance to vertical pressure is consequently obtained, and the lateral stability of the rail is secured. The rails are to be laid in earth, ashes, or broken stone and gravel, and the sustaining surface of the earth may have any requisite density communicated to it by rolling or beating the earth at the sides, so as to give it sufficient density to resist the pressure to which the rail is to be subjected. The mass being composed of materials which will not readily yield or slip away, will be incapable of further condensation by any subsequent pressure not exceeding that to which it had been originally subjected by the beaters or rollers acting at the sides.

The rails which Mr. Reynolds uses are of two kinds; rails wholly of cast iron, cast in one piece, and rails either of wrought or cast iron laid on a sill of wood, the wood being placed in a cast iron bearer of the shape already described. The rails, sills, and bearers in this latter construction, break joint with each other, and are held together by bolts passing through all three. Thus one continuous structure is formed throughout the whole line, and the fracture of three parts in the same place is highly improbable. The vibrations will be neutralized by the sill of wood acting as a partially elastic cushion in receiving the concussion to which the rails are subjected; and this latter mode of construction is considered preferable as admitting of the use of either cast or wrought iron rails.

February 21, 1837. Bryan Donkin, Esq., in the Chair.

The construction of railways on the principle of continuous bearing, as adopted by Mr. Reynolds, and described in his paper read at the last meeting, was discussed. Some of the rails and bearers cast in a single piece, having been laid on Chatmoss, inquiries were made as to how they had answered. It was stated that they were kept in order at less trouble than the others, and that they showed no tendency to sink. It was intended to use the commonest timber for the sills; the wood having been boiled in tar, and allowed to cool in the tar, becomes so saturated with tar that it will not imbibe moisture. Ibid.

Mechanics' Register.

Medal Striking.

We have much pleasure in announcing to the friends of the fine arts that Mr. Pistrucci, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and shall yet make a medal identically the same with the original model in wax, an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver, or copper, by striking it according to the usual process. It will at once be seen that this is a very different operation from that by which cast medals are manufactured. It is as simple as it is ingenious, and Mr. Pistrucci having no intention of taking out a patent for the discovery, and being anxious to give to the public the full benefit of it, in the different processes of manufacturing plate, jewellery, and all kinds of ornamental work in metal, announces that the whole of the process consists of the following method:—The model being made in any substance, wax, clay, wood, or other fit material, a

mould of it is taken in plaster, from which mould, when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come up sharply, and the iron attain the hardness almost of a steel die hardened. The cast iron impression is then flattened mathematically true on the back, and fixed in a steel die, the hollow of which is turned to the exact size of the cast iron, and is set within the rim or border, hammered as close as possible, so as to form a collar. The metal upon which the impression is to be struck, (to form either the medal itself, or a steel matrix if desired,) is to be fashioned into the shape of a cone in the ordinary way, perfectly flat at the base, heated red hot, and placed at the bottom dish of the press. When the die, fitted as above, having been previously placed at the top dish, and the workmen quite ready to give the blows instantly, three or four, as may be required, a perfect impression of the cast iron will be attained without the least injury to it. Of course it will be necessary, previous to the die being used, for the artist to polish the surface. Mr. Pistrucci's first experiment was successfully performed upon a punch of hard copper, with his model of the medal of Sir Gilbert Blane, being nearly three inches in diameter; and he has no doubt that it will equally succeed on a steel punch, perhaps, too, without its being necessary to heat it. When the process above described shall have been brought to the perfection of which it is capable, there can be no doubt that in the execution of works of this description it will not only be the saving of the labor of months or years in the engraving of dies, and, consequently, of great expense, but the work to be executed will in all points be, in an instant, an exact fac simile of the original conception of the artist, instead of representing, as at present, merely the handiwork of the engraver, copied from such original. It will also dispense with the use of the very expensive machinery, such as the *tour a portrait*, introduced into the mint by Mr. Pistrucci several years ago, which, however apparently correct in its productions, can never give a perfectly true semblance of the original, even to the limited extent to which it is applicable. And we may possibly be led by it to discover the mode by which the artists of antiquity succeeded in producing these beautiful coins, in which the softness and boldness of the fleshy parts have never yet been equalled by any modern engraver in steel. Lond. Mec. Mag.

Water Power.

The discovery of a new application of water power, which is likely to be attended with most important consequences, has been lately made by a tradesman in this town. Like all truly valuable discoveries, it is distinguished alike for simplicity and efficiency. It consists of a cylinder and a piston similar to those employed in a steam-engine. To the cylinder there are two entrance and two discharge pipes, one of each on either side of the stuffing-box of the piston. The same turn of the cock that admits the water into the one part of the cylinder opens the discharge pipe in the other, and thus a vacuum is formed. To work this, advantage is taken of the pressure of the Shaw's Water, the height of the reservoir of which gives it a force of 60lb. to the inch in the lower parts of the town. A short time ago we witnessed an experiment

with a cylinder two inches in diameter worked with a jet of water of somewhat less than a quarter of an inch in diameter, and the piston, although loaded with 1½ cwt., rose and fell sixteen times in the minute. In this case the entrance and discharge pipes were equal in size, and the cylinder was placed in a vertical position. Since then the discoverer has had another model made with the cylinder laid horizontally, and with the discharge pipes nearly three times as large as the entrance ones, and by this means the motion was increased to twenty-six double strokes in the minute.—*Greenock Advertiser.* Min. Jour.

Galvanic Telegraph.

The mode of making instantaneous communications by galvanic power has been put to the most decided test on the London and Birmingham Railway, under the direction of Professor Whetstone and Mr. Stephenson, the Engineer. Four copper wires, acted upon at each end of the line at pleasure, by the agency of very simple galvanic communicators have been laid down on the line of the railroad to the extent of 25 miles. They are enclosed in a strong covering of hemp, and each terminus is attached to a diagram, on which the twenty-four letters of the alphabet are engraved, in relative positions, with which the wires communicate, by the aid of movable keys, and indicate the terms of the communication. The gentlemen to whom we have referred, we believe, are fully satisfied that communications to almost any extent may thus be made instantaneously by the agency of galvanism.—*True Sun.* Lond. Mec. Mag.

The Circular Cut.

Most persons remember their surprise, when children, at the great length of thong supplied from a small piece of leather, by the spiral, or, as it is technically called, "the circular cut." The wonder was worked up into a fable, for Dido was said to have obtained the ground on which Carthage stood, by bargaining for as much as a bull's hide would enclose, and then cutting the hide into thongs, so as to take in a space far larger than the seller expected. This story has gone the round of the world. A friend of ours was informed in Persia, that the English obtained possession of Calcutta by the very same stratagem; the Chinese tell the story of one of their emperors; and the North American Indians believe that this was one of the countless artifices by which the white men deceived their brethren. Athenæum. Ibid.

English Railway Stock at Liverpool.

The prices of some or the best of these stocks were,

	Par.	July.	August.
Liverpool and Manchester	£100	£210	£208
Warrington and Newton	100	179	179
London and Birmingham	85	144 10	140
Grand Junction	90	180	170
Leeds and Manchester	10	14 5	13 10
Edinburgh and Glasgow	2	2 7 6	2 7 6

Mining Journal.

Lunar Occulations for April 1838.

LUNAR OCCULTATIONS FOR PHILADELPHIA, APRIL 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
6	14	22	Im. δ Leonès	,4,	80°	128°
6	15	22	Em.		213	264

Meteorological Observations for November, 1837.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P. M.	Barometer Sun rise.	Barometer 2 P.M	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	32°	54°	29.-5	29.85	W.	Moderate.		Clear—do.
	2	36	52	29.85	29.90	W.	Brisk.		Clear—do.
	3	37	54	30. 5	30. 5	W.	Moderate.		Clear—do
	4	38	60	29.95	29.90	W.	do.		Clear—do.
	5	58	70	29 60	29.50	SW.	Blustering.	.8	Cloudy—rain.
	6	44	54	29.60	29.70	W.	Moderate.		Clear—do.
☾	7	42	53	29.65	29.80	W.	Brisk.		Clear—do.
	8	36	45	30.20	30 30	NW.	Moderate.		Clear—do.
	9	31	52	30.35	30.25	E.	do.		Partially cloudy—do. do.
	10	50	63	29.95	29.95	SW.	do.		Cloudy.—partially do.
	11	41	52	30.10	29.95	W.E.	do.	,50	Cloudy—do —rain in night.
	12	55	61	29.50	29.55	W.	Brisk.		Cloudy—partially—do.
	13	35	49	29.90	29.90	S.	Moderate.		Clear—do.
☉	14	32	33	29.70	29.60	NW.W.	do.	.60	Snow—snow.
	15	26	40	30.00	30. 5	W.	do.		Clear—do.
	16	32	43	30.25	30.10	W.	do.		Cloudy—do.
	17	26	46	30.35	30.3	W.	do.		Clear—do.
	18	36	54	30.20	30.20	SW.	do.		Cloudy—partially do.
	19	52	62	30.00	30.00	S.	Blustering.		Partially cloudy—clear.
	20	51	67	30.10	30.05	S.	Moderate.		Partially cloudy—clear.
☽	21	49	67	29.97	29.85	SW.	do.		Clear—do.
	22	53	61	29.50	29.30	SSE.	do.	.16	Cloudy—do—rain.
	23	32	39	29.10	29.20	W.	Brisk.		Clear—do.
	24	31	34	29.35	29.40	W.	Moderate.		Cloudy—do—Flurry of snow.
	25	25	30	29 50	29.60	W.	Brisk.		Clear—lightly cloudy.
	26	19	33	29.87	29.95	W.	Moderate.		Clear—do.
	27	25	38	30.20	30.30	W.	do.		Clear—clear.
	28	25	46	30.35	30.35	E.SW.	Calm.		Clear—lighly cloudy.
⊗	29	39	54	30.25	30.20	SW.	do.		Fog—lightly cloudy.
	30	46	59	30.25	30.10	W	do.		Clear—do.
	Mean	38.00	50.83	29 92	29.91			1 64	

		Thermometer.	Barometer.
Maximum	height during the month	70.00 on 5th.	30.35 on 9th 17th 28th
Minimum	do.	19.00 on 26th.	29.10 on 23rd.
Mean	do.	44.42	29.91